San Francisco Bay Area Network
Inventory and Monitoring Program
National Park Service

Inventory Summary Report 2000-2004
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INVENTORY SUMMARY REPORT 2000-2004

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Executive Summary

The purpose of this document is to report on the accomplishments of the Inventory Program for the eight national parks in the San Francisco Bay Area Network (SFAN). The National Park Service's (NPS) Inventory and Monitoring Program (I&M) provided $682,430 to the SFAN over five-years between 2000 and 2004 to obtain needed baseline information. Completion of the baseline inventories, such as vegetation mapping and certified species lists, was important to the SFAN parks because they have a high biodiversity at great risk. It is also the first step towards development of the monitoring program.

Six parks with significant natural resources in the central California region create the core of the SFAN I&M program. The six parks include three medium-sized parks: Golden Gate National Recreation Area (GOGA), Pinnacles National Monument (PINN), and Point Reyes National Seashore (PORE). The SFAN includes small historic areas with significant natural resources: Fort Point National Historic Site (FOPO), John Muir National Historic Site (JOMU), and Muir Woods National Monument (MUWO). Eugene O'Neill National Historic Site (EUON) was added because it is jointly managed with JOMU and is surrounded on three sides by Las Trampas Wilderness Park. The Presidio of San Francisco (PRES) was added for important natural resources such as the restored dunes and marsh at Crissy Field. GOGA administers FOPO and MUWO.

The *Study Plan to Inventory Biotic Resources of the San Francisco Bay Area National Parks* (2000) was approved by the national I&M program and served as the work plan. The SFAN initiated 32 inventory projects between 2000 through 2004. The majority of the inventory funds (85%) went to twenty-two of the projects from the approved Study Plan. The Data Manager salary was funded from the monitoring account rather than the inventory account freeing up funds for the expansion of existing and addition of new inventories. Six projects were initiated from the unfunded needs in the Study Plan (6% of the budget) and four were added as new projects (7%). The remaining funds were used to purchase supplies and equipment, to support travel to servicewide workshops, and to provide vehicles for local travel.

Leveraging of time and funds from other sources resulted in a five-year inventory program of more than $1,441,630 to improve understanding and protection of SFAN natural resources. The majority of the non-inventory funds came from the vital signs monitoring program ($480,073, 46.9%). Organizations contributed to build a more robust program and added $191,680 (13.3%), much of that supporting the Tomales Bay Biodiversity Inventory. Volunteers donated time to participate in almost every inventory project ($47,247, 3.3%).

The SFAN made excellent progress on eight of the twelve basic natural resource inventories identified by the servicewide programs. All parks used the bibliographic software to store and track citations. All parks have base cartographic data, meteorological data, and species occurrence data for vertebrates and vascular plants. By the end of FY07, all parks will have vegetation maps. EUON has a cultural landscape map and PINN has a draft vegetation map. All parks have soil maps, even though the maps for PINN, PORE and JOMU need updating. Scoping for the geology map will occur in FY06. A water resource inventory has been conducted for all parks with significant water resources (all but FOPO). The air quality inventory and related values assessment is incomplete, predominantly covering parks with Class I air space (PINN and PORE). Selected biological surveys were made for special taxa.

Data miners searched for and entered voucher and document records into national software applications that track citations (NatureBib) and species presence (NPSpecies). A total of 3,795 vouchers, 318 records, and 28,990 observations were added to document species presence in the parks. Most of the evidence was for vascular plants for the GOGA administered parks. A total of 4,082

species were added to NPSpecies. By the end of FY04, 17 park species databases were certified as accurate with documentation; by March of 2006, 38 lists were certified. These organism lists can now be used with certainty that the species are in the parks.

By the end of FY04, 21 of the 28 field surveys of different taxa were completed (75%). Once all products from the project were completed, they were submitted to the National I&M office in Ft. Collins, Colorado, where they were archived and made available to the public through an online source called the Biodiversity Service Center (http://science.nature.nps.gov/im/inventory/biology/). By the end of FY04, 28% of the final products from inventory projects had been submitted to the national office. Most of the remaining inventory products are scheduled to be completed by 2006.

Over 90% of all vascular plant and vertebrate species listed for the SFAN parks now have documented evidence of their presence. This meets a major servicewide program goal. Many inventories provided the first systematic survey of particular taxa for the park. The East Bay parks (EUON, JOMU), for example, had no previous natural resource surveys. In 2000, almost 7,900 acres of Bureau of Land Management land were transferred to PINN through a boundary enlargement. The area had no previous biological surveys. Numerous new species were discovered during these and other field surveys. Preliminary numbers of species added to park databases include the following:

Vascular plants	720
Lichens	293
Terrestrial invertebrates	70
Aquatic macroinvertebrates	248
Amphibians	24
Reptiles	33
Fish	13
Birds	466
Mammals	79
TOTAL number of species	1,946

The inventories generated and dispersed data in several forms. Researchers provided final reports including distribution maps and species lists from the inventories. If specimens were collected, documentation was catalogued in museums. The data from inventories also populated several national databases including NPSpecies and NatureBib. Additionally, parks creatively generated other ways to provide access to inventory data. For example, PINN developed a web page listing and describing 38 species of dragonflies and damselflies discovered during the riparian survey. JOMU staff took digital photographs of the herbarium specimens that were collected, mounted and labeled in preparations for the creation of a virtual herbarium in a display or on a website.

Selected highlights from the inventories include the following:

A few species new to science were discovered during the inventories. A new freshwater aquatic worm in the genus *Eremidrius* was found during the aquatic riparian inventory at PINN. One other new species was uncovered during the Tomales Bay Biodiversity Inventory (GOGA and PORE). Scientists found a crustacean in the genus *Nebalia.*

During the four years of rare plant surveys in PORE, three species new to the park were discovered and 148 unrecorded rare plant populations were documented. These findings increased the rare plant populations monitored and managed by PORE by 34%.

Two of the new lichen sightings at PINN documented a first, the globally rare *Texosporium jacobi-sancti* growing on wood and soil. Previously it had been found growing solely on old rabbit pellets. Future search parameters for this species will be expanded.

The federally endangered California freshwater shrimp (*Syncaris pacifica*) was found in Olema Creek, PORE, during a 2002 survey of 13 creeks in GOGA and PORE. By working with ranchers to repair and replace fencing and to remove litter along Cheda, Zanardi, McIsaac, Kehoe, and Home Ranch Creeks, the future habitat for the shrimp and other native organisms will be improved.

Inventories documented new habitats for the federally threatened California red-legged frog in Tennessee Valley, GOGA, where it had not been observed for over a decade. The inventory of amphibian use of wetland seeps, springs, and streams in 2003-2005 discovered frogs breeding at two study areas. In addition, the 2001-2004 riparian aquatic species survey at PINN documented successful reintroduction of this frog species to Chalone Creek. Dispersal and reproduction were subsequently documented in several downstream locations.

Researchers discovered two new colonies of Ashy Storm-Petrels in PORE at Chimney Rock and Stormy Stack at Double Point. This is an indication that petrels are more widespread in central California than previously thought. The wider breeding distribution lessens the threat of a localized catastrophe extirpating the entire population.

Bat surveys in 1999-2001 discovered maternity colonies in redwood hollows near paved trails at MUWO where there are over 1.5 million visitors per year. This co-existence hinges on the diligence of MUWO staff to prevent visitors from straying off trails and entering or disturbing the redwood hollows.

The parks were also successful in building and enhancing partnerships to accomplish inventories. Partnerships included alliances with the National Oceanic and Atmospheric Administration, the National Marine Fisheries Service, the Bureau of Land Management, the California Department of Parks and Recreation, the US Department of Agriculture, the California Department of Fish and Game, the University of California, San Francisco State University, Sonoma State University, Humboldt State University, and PRBO Conservation Science.

This report describes the inventory program objectives and the progress made on each objective. The administration of the Inventory Program, data management, budget, contracts and agreements are also provided in this document. In addition to the status of the inventories, the unfunded needs are listed. Summaries are provided in the body of the report and details are provided in the Appendices.

The accomplishments in this report are a result of the hard work from park staff taking on the Inventory Program duties as an ancillary duty added to their regular work load. They are all to be commended and are listed in Appendix F. We all thank you.

I. Overview and Objectives

The purpose of this document is to report on the accomplishments of the Inventory Program for the group of eight national parks in the San Francisco Bay Area (SFAN). The National Park Service's Inventory and Monitoring (I&M) program provided funding to the SFAN for five-years of inventories based the *Study Plan to Inventory Biotic Resources of the San Francisco Bay Area National Parks*. This document summarizes the projects, the accomplishments, usefulness of the information, and the budgets, contracts, and personnel used to implement them.

Completion of baseline inventories has been highly important to the SFAN parks because they have a high biodiversity at great risk. The SFAN falls within a significant "hot spot" in the world for biodiversity at great risk due to rapid human population growth (Cincotta and Engelman, 2000). With a current population of 6.9 million and large metropolitan centers, the San Francisco Bay Area is forecast to have a population of 8 million by 2020 (Association of Bay Area Governments 2000).

Natural Resource Challenge

Top leaders of the National Park Service met at Mount Rainier National Park on August of 1999 to develop the concepts behind a five-year action plan, The Natural Resource Challenge, to care for natural resources in the parks within the complexities of today's modern landscapes. They recognized that "preserving our countries precious natural heritage for this and future generations … requires active and informed management based on sound science." Urban development, habitat destruction, non-native species invasions, and air and water pollution have damaged natural ecosystems and ruined scenic vistas. The action plan calls for substantially increasing the role of science in decision-making, revitalizing and expanding natural resource programs, gathering baseline data on resource condition, strengthening partnerships with the scientific community, and sharing knowledge with educational institutions and the public. "Parks provide unparalleled opportunity to understand the complexities of nature…." Then Director Robert Stanton continued, "With this effort, the national parks will remain not only scenic vacation destinations but also natural laboratories, libraries, and classrooms."

Several strategic approaches were developed. The NPS decided that most of the necessary actions to protect the natural biological richness and integrity of the parks were best tackled on-the-ground, principally within and by the parks themselves, supplemented with project funding. The concepts in the action plan were so encompassing that in order to implement them the NPS needed to collaborate and coordinate with public agencies, universities, and non-governmental organizations.

Previously identified by NPS in the NPS-75: Natural Resource Inventory and Management Guideline (NPS 1995), a strategic approach was designed to collect a consistent set of basic data on natural resources in order to understand processes that maintain and preserve the national parks. Natural ecosystems are extremely complex and their protection hinges on the identification and understanding of their key components, including living things, natural processes, and landscape features. The goal was developed to complete the basic inventories in all national parks with significant natural resources. Twelve basic data sets were identified. The agency responsible for completing the inventory is in parenthesis:

- Automated bibliography (NPS through Nature Bib database)
- Base cartography data (U.S. Geologic Survey)
- Species occurrence inventory (NPS through NPSpecies database)
- Species distribution inventory for species of concern (NPS through field surveys)
- Vegetation maps (NPS with the U.S. Geologic Survey)

- Soils maps (NPS with the Natural Resource Conservation Service and state geologic agencies)
- Geologic maps (NPS with the U.S. Geologic Survey and state geologic agencies)
- Water resource inventory (NPS Water Resources Division)
- Water chemistry inventory (NPS Water Resources Division)
- Air quality inventory (NPS Air Resources Division and U.S. Environmental Protection Agency)
- Air quality-related values assessment (visibility) (NPS Air Resource Division)
- Meteorological data inventory (NPS Air Resources Division and states)

Between 1989 and the late 1990s, funding was limited to complete the basic inventories; however, after development of the Natural Resource Challenge (NRC) in 1999, the program was accelerated. During the first five-years of the NRC, the NPS concentrated on the biological inventories of vascular plants and vertebrates. Once these basic inventories have been completed, the NPS will address other important inventories such as marine algae and invertebrates, fossils, natural soundscapes, and dark night skies.

To ensure that the inventories result in the highest-quality and most-useful scientific information, the NPS developed three criteria for inventory efforts:

- Each inventory must produce "core" or baseline information that park managers need to effectively protect resources.
- Each inventory must be conducted in accordance with specified protocols and quality assurance standards.
- Data obtained from each inventory must be compatible, allowing synthesis and analysis at broader levels.

In order to implement the strategies, the NPS organized the 270 park units with significant natural resources into 32 inventory and monitoring networks. The groups of parks were linked through similar geographic and shared natural resource characteristics to facilitate collaboration, information sharing, and cost savings. It was thought that each network of parks would work with other protected areas, people, and organizations in their common landscape. The San Francisco Bay Area Network (SFAN) encompasses the parks in central coastal California.

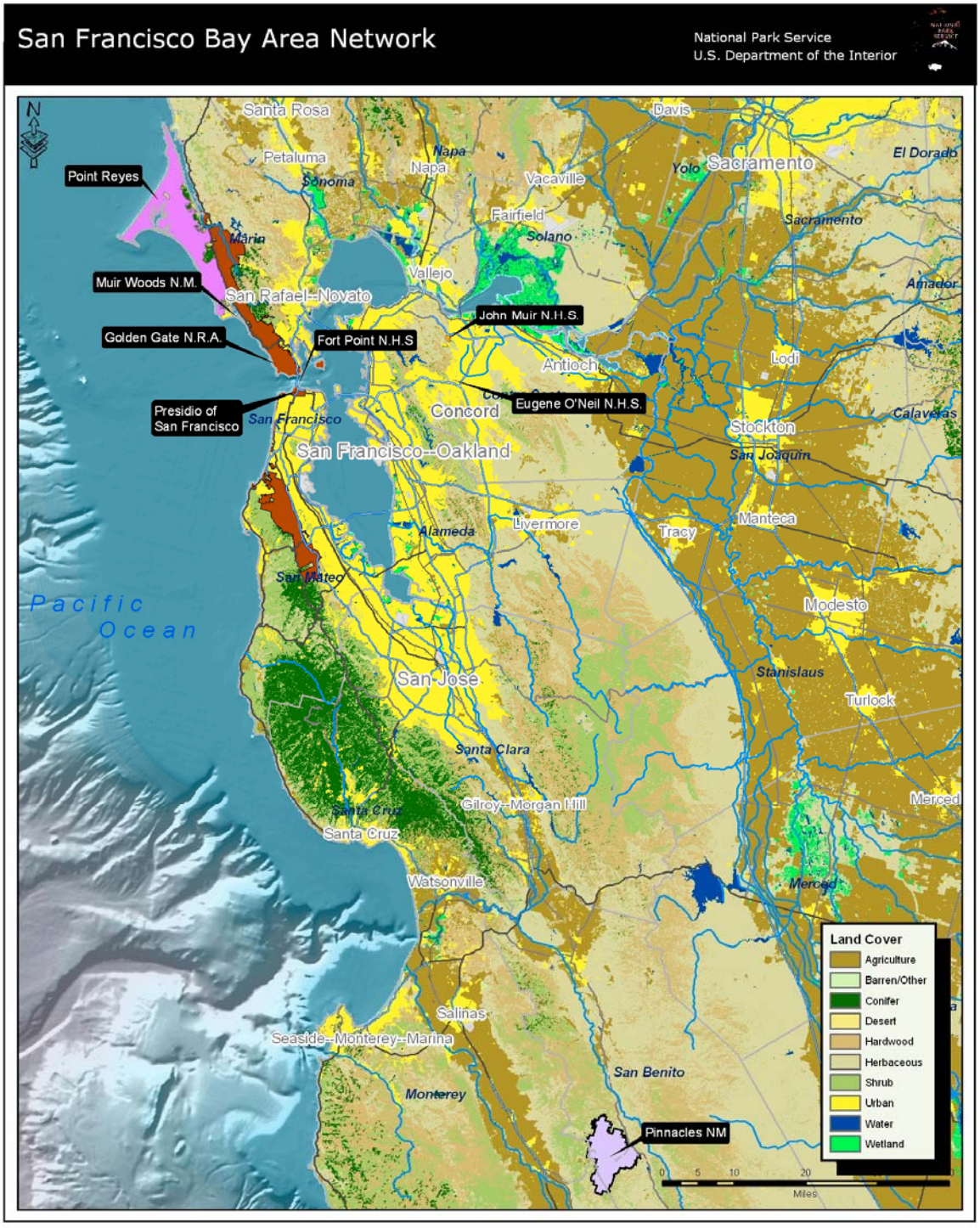
In FY99, 7.5% of the NPS budget was devoted to natural resource management and less than 5% of the permanent staff worked in jobs directly related to natural resource preservation. The backlog of natural resource mitigation projects was documented to total $186 million. Other needs included $15 million for threatened and endangered species, and $16 million for invasive species activities. To meet the backlog would require over a 50% increase above what parks were spending on all natural resource management activities. A five-year funding program was developed to address these deficiencies and to fund the action plan. The President's FY00 budget contained a nearly $20 million increase in funds designated to acquire information for science-based decision-making through the Inventory and Monitoring (I&M) Program and other natural resource programs. Subsequent budgets have also reflected the long-term commitment to acquiring information to better inform park managers, although at reduced levels, resulting in incomplete implementation of the proposed programs of the NRC

Parks in the San Francisco Bay Area Network

The National Park Service recognized six parks with significant natural resources in the central California region. These parks create the core of the SFAN I&M program. SFAN includes three

medium-sized parks: Golden Gate National Recreation Area (GOGA), Pinnacles National Monument (PINN), and Point Reyes National Seashore (PORE). The SFAN also includes some small historic areas with significant natural resources: Fort Point National Historic Site (FOPO), John Muir National Historic Site (JOMU), and Muir Woods National Monument (MUWO).

Map 1. Location of the SFAN parks in central coastal California.



The SFAN decided to include two additional parks that were not identified on the national list of 270 parks with significant natural resources for which the servicewide program was designed. The Presidio of San Francisco (PRES) has several areas of significant natural resources, such as Crissy Field. The SFAN also included Eugene O'Neill National Historic Site (EUON) because it is jointly managed with JOMU and is surrounded on three sides by Las Trampas Regional Wilderness Park. Therefore, wildlife may migrate through EUON and significant plant communities occur nearby.

The SFAN Network has two spatially nested boundaries: an inner core and an outer limit. The core is composed of the land within the NPS boundaries and adjacent state parks and watershed lands. The coastal boundary extends from Tomales Point, Marin County, in the north to Milagra Ridge, San Mateo County to the south. The eastern and southern extreme is inland in the Gabilan Mountains of San Benito County. The outer limit is delineated by the broader boundary of the Golden Gate Biosphere Reserve, the three adjacent National Marine Sanctuaries (Cordell Bank, Gulf of Farallones, and Monterey Bay), Bureau of Land Management lands, and the mouth and center of San Francisco Bay.

Environmental setting

Climate is the broad-scale, long-term pattern of weather which drives distribution and abundance of biota. The eco-region between 30 degrees and 45 degrees N Latitude is characterized by hot, dry summers and rainy, mild winters typical of a Mediterranean climate and distinguished by alternate wet and dry seasons. Precipitation typically occurs as rainfall, not snow. Coastal areas have a more moderate climate than the interior and can receive significant moisture from fog in the summer. Consequently, inland areas receive about half the rainfall as areas along the coast range. With this variability, many microclimates occur. For example, the summer the Point Reyes Headlands can be 55°F with fog and wind in contrast to Olema Valley, just 15 miles distant, with temperatures above 80°F and no wind (National Weather Service 2003).

This Mediterranean climate has a long growing season, 120 to 270 days. The area hosts a disproportionate share of plant species worldwide in both the number of species and the number of rare or locally endemic species (Dallman 1998). Terrestrial vegetation is typically dominated by hard leaved evergreen trees and shrubs that can withstand severe drought and evaporation in the summer. The pattern of plant community distribution consistently has forest on north facing slopes and wetter sites, chaparral/scrub on south facing slopes and drier sites, and riparian corridors between ridges and along valleys (Bailey 1995). Larger scale climatic cycles, such as Pacific Decadal Oscillation and El Nino Southern Oscillation events, affect temperature and precipitation patterns and produce significant changes in abiotic and biotic ecosystem components.

Geologic history has shaped the topography of the region creating large bays, coastal ridges paralleling the coastline, and unusual features. Ridges include the Inverness and Bolinas Ridges, the northern Diablo Mountains inland of San Francisco Bay, and the Gabilan Mountains in the south. Special features include the rhyolite breccia volcanic Pinnacles rock formations and the granitic Point Reyes headland capped with Paleocene sedimentary rocks.

Plate tectonics are still active. The ancestral San Andreas Fault links all of the park units. The fault starts at the Pinnacles in the middle of Miocene volcanics formed 23 millions years BP and extends northward to Point Reyes where it ruptures the surface and forms Bolinas Lagoon and Tomales Bay. The land to the west of the fault continues a northward movement.

Earthquakes along the San Andreas Fault are a significant force exposing new rock surfaces and minerals through uplift and rock shearing. Mass movement or landslides break down geologic

materials either rapidly through rock falls and slides or more slowly as slumping or creep. Other natural forces such as wind, water, and fire also affect the biotic components of the biomes. These processes set and reset the stage for colonization and establishment by diverse biological communities.

Convergence of ocean currents rising from the abyssal plain over a steep submarine cliff makes the marine and coastal habitats complex and diverse. The California coast is only one of five areas of eastern boundary coastal upwelling, oceanic currents worldwide and the only one in North America (Thurman 1988). In addition, a plume of warm freshwater exits the San Francisco Bay and extends as far as the Gulf of the Farallones. These nutrient-rich waters support abundant and diverse fauna and flora. More than one-third of the world's cetacean species occur in these waters.

Aquatic resources in the SFAN include streams, bays, estuaries, lagoons, lakes, reservoirs, seeps, springs, and freshwater and estuarine marshes. Hydrologic systems are relatively flashy, with high runoff in winter and very low to intermittent flow dominating summer conditions. There are around 130 linear miles of streams within the inner core of the SFAN. Lobos Creek in the PRES is the only free-flowing, above ground creek in San Francisco. Watersheds are relatively small:

Name of watershed	Square mileage
Franklin Creek (JOMU)	0.5
Redwood Creek (GOGA/MUWO)	9.0
Olema Creek (PORE)	14.5
Pine Gulch Creek (PORE)	65.0
Chalone Creek (PINN)	70.0
Lagunitas Creek (GOGA/PORE)	88.0

The combination of marine and freshwater systems within SFAN creates a high diversity of species. In 1974, The State Regional Water Quality Control Board (RWQCB) established five Areas of Special Biological Significance (ASBS) that fall within the SFAN area. These include the Point Reyes Headlands, Bird Rock, Double Point, Duxbury Reef, and the Fitzgerald Marine Reserve. These areas were nominated based on water and habitat quality and are limited to coastal areas.

Eight water bodies within and adjacent to NPS lands have been identified as impaired by the RWQCB. Fecal coliform bacteria, high sediment loads, and nutrients are the most common pollutants or threats to park resources. All urban creeks in the San Francisco Bay area are considered impaired by diazinon. The RWQCB requires monitoring of these water bodies and has developed a timeline for improvement (Cooprider 2004).

The major biomes of the parks include forests, grasslands, and savannahs. Detailed information about the parks can be found in Appendix A and in the SFAN Vital Signs Monitoring Plan that can be viewed on the SFAN website at www1.nature.nps.gov/im/units/sfan/.

The eight SFAN parks encompass a large number of ecosystems and microhabitats within a total of 197,257 acres. Of that, 166,458 acres are terrestrial and 31,101 acres are marine waters. The linear shoreline of the SFAN is 160.2 miles, including FOPO, GOGA, PINN and PRES. The Network encompasses an important area of the California coastline which marine mammals and seabirds need for part of their life cycle. Lower human use and effects to the resources are expected in the two Congressionally designated Wilderness areas, at PINN and PORE. These areas are good reference sites for studies examining anthropogenic change. Edge effects are a concern in most of the parks. GOGA, in particular, has a very fragmented landscape. Therefore, mitigation and restoration are needed to maintain natural processes and biota. Erosion and stream sedimentation are problems in many of the

Network watersheds. Threatened and endangered (T&E) species are also a concern, requiring special efforts to protect both species and habitat. Table 1 shows the acreage for terrestrial lands, marine lands, and Congressionally designated Wilderness and the number of miles of coastal shoreline for each park.

Table 1. Size of Network parks.

Park	Acreage: Terrestrial	Marine	Wilderness	Miles: Coastal/Shoreline
EUON	13	0	0	0.0
FOPO	29	0	0	0.4
GOGA	68,973	8,799	0	72.1
JOMU	345	0	0	0.0
MUWO	554	0	0	0.0
PINN	24,000	0	18,000	0.0
PORE	71,046	22,000	32,000	84.2
PRES	1,498	302	0	3.5
Totals	166,458	31,101	50,000	160.2

Objectives for the SFAN Inventory Program

The National I&M program identified 12 key areas to focus inventory efforts, concentrating primarily on biological resources, water quality and landscape mapping with an emphasis on using geographic information system technology to organize, display and analyze the information obtained through physical and biological inventories. The national goal was to complete inventories of vascular plants and vertebrates for all of the 270 parks with significant natural resources within five years. Another programmatic goal was to accelerate the completion of vegetation maps since the information was needed in planning sample design for inventories and for vital signs monitoring. Water resource inventories were also emphasized.

The servicewide goals were adopted by the SFAN Network and included the following:

- Compile and evaluate existing documents, specimens, and spatial information for each park into standard NPS databases, and ensure such information is accurate.
- Complete the documentation of 90% of vertebrate and vascular plant species in the parks through targeted field investigations and ensure that the species are accurately documented and vouchered.
- Inventory taxa of special interest identified in the Network's *Inventory Study Plan* and develop spatial distribution maps and estimates of abundance or condition.
- Complete baseline vegetation mapping for the Network.

The SFAN developed three additional goals in order to meet other needs and programmatic demands. Important issues requiring more information for the SFAN included understanding and knowledge about unique geologic features in PINN, active geologic fault zones, sediment erosion, and water and air pollution. The SFAN had exceptional opportunities to work with partners, especially the community effort to conduct an all-taxa biodiversity inventory of Tomales Bay in PORE. Coordinating with partners was a goal of the Natural Resource Challenge. Another goal of the Challenge was to share information. Therefore the following three additional inventory goals were to:

- Complete selected abiotic inventories.

- Coordinate with other natural resource inventory studies.
- Implement strategies to share inventory information.

SFAN Inventory Study Plan

Each Network developed an inventory study plan that was approved by the Washington Office in order to obtain funding for the five-year I&M program. Approval and funding levels of the Inventory Plans were based on threat to resources, significance of resources, and ability to implement the Plan. Those ranked the highest and were logistically feasible were implemented first. Since the SFAN has high biodiversity at great risk, it was selected to begin in 2000.

Inventories listed in the *Study Plan to Inventory Biotic Resources of the San Francisco Bay Area National Parks* (Press and Semenoff-Irving 2000) were based on the priorities established through scoping workshops of regional scientists and resource managers, and from recommendations from a group of technical specialists through a Technical Steering Committee. The SFAN Board of Directors, consisting of the superintendents of the parks, approved the needs, priorities, and phased implementation designed in the Study Plan. Once progress could be demonstrated, some of the inventories that had not been selected for full funding in the Study Plan could be implemented.

Annual Work Plans and Reports

The first detailed, annual work plan was developed by the Technical Steering Committee, approved by the Board of Directors, and submitted to the servicewide I&M Program in 2000. At the end of each fiscal year, the SFAN I&M program documented accomplishments and expenditures, and developed a work plan for the next fiscal year. Since 2004 was the fifth and final year of National I&M Program inventory funding, the SFAN decided that a summary of accomplishments would be a useful document to augment and summarize the annual reports.

II. Accomplishments

The SFAN made excellent progress on most of the twelve inventories that are considered basic for all parks with significant natural resources (Table 2). All parks entered documents into NatureBib, the servicewide automated bibliographic database. This was a precursor for linking species to evidence in NPSpecies, the servicewide biological taxa database.

Table 2. Status of natural resource baseline inventories. (Yes means that the park has completed the inventory and has the baseline data; * means updating needed for all parks)

Inventory type	Park: EUON	FOPO	GOGA	JOMU	MUWO	PINN	PORE	PRES
Automated bibliography (NatureBib)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Base cartographic data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vegetation maps	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Soils maps *	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geologic maps	No	No	No	No	No	No	No	No
Species occurrence inventory	Refer to Table 4 ------							
Species distribution inventory	Refer to text, project and species specific -----							
Water resource inventory	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Water chemistry inventory	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Air quality inventory	No	No	No	No	No	Yes	Yes	No
AQ-related values assessment	No	No	No	No	No	Yes	Yes	No

Meteorological data inventory	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Vegetation mapping progressed well for most parks supported by the servicewide I&M program and with funds from elsewhere. A vegetation map was completed for FOPO, GOGA, MUWO, PORE and PRES and then separately for JOMU and the PINN new lands. An historic cultural landscape study was completed for EUON, a predominantly cultural park, to describe 90% of the land cover. All parks have dated soils maps with the greatest need for updated maps at PINN and JOMU. None of the network parks have a geologic map, so a technical request for assistance was submitted to the NPS Geologic Resources Division and initial scoping will be scheduled for FY06.

The NPS Water Resource Division (WRD) Baseline Inventory and Analysis reports were completed for EUON, GOGA and their administered areas (MUWO, PRES), and PORE. The report for JOMU was completed in 1998. The report for PINN is underway. No report will be done for FOPO, since it does not have significant freshwater resources. These reports were a result of cooperation between the NPS I&M program, the NPS-WRD, and Horizon Systems Corporation to retrieve, format, and analyze surface water quality data for parks containing significant water resources. The documents provided a complete inventory of all retrieved water quality parameter data, water quality stations, and the entities responsible for the data collection as well as descriptive statistics and graphs characterizing the period of record, annual and seasonal trends. A comparison of the park's water quality data was made to relevant EPA and WRD water quality screening criteria. The reports included data for waters at least three miles upstream and one mile downstream of park boundaries. The water resource program is funded separately from the I&M program and has different reporting parameters.

In addition to the Baseline Inventory Reports, SFAN contracted with the University of California, Berkeley, to review and analyze the data from the GOGA, PINN, and PORE WRD reports and several other reports. Stafford and Horne (2004) includes a comprehensive discussion on each water quality parameter currently or historically monitored by the three parks. Analysis included natural range of variation and water quality limits to provide critical knowledge for understanding, managing and monitoring these aquatic systems.

The NPS Air Resources Division (ARD) is currently only able to monitor and track air quality in Class I parks. Designations were established by Congress through the Clean Air Act. Class 1 designations were established by Congress through the Clean Air Act and include NPS units that are greater than 6,000 acres for parks and greater than 5,000 acres for wilderness areas for units that were in existence on August 7, 1977. A state may designate an area established after that date as Class I. There are 48 NPS units that have Class I designations, two of which are in the SFAN – PINN and PORE. For both parks, the principle air pollutants of concern are ozone precursors (nitrogen oxides and volatile organic compounds) from mobile sources and particulates from dust, agricultural activities, burning, and construction. Both parks are monitoring wet deposition, ozone, and visibility.

An air quality related value (AQRV) is a resource identified by the federal land manager that could be adversely affected by a change in air quality. The AQRVs can include visibility, dark night skies, surface water quality, soils, vegetation, and fish and wildlife. In 2001, PINN completed a baseline inventory of the surrounding night time light emissions for the dark night sky baseline. In addition to AQRVs, PINN has two registered integral vistas. More information about AQRVs can be found at www2.nature.nps.gov/air/index.cfm

Much of the network's effort was expended in obtaining the biological inventories of vascular plants and vertebrates. The accomplishments for these projects are described throughout this section of the report.

The SFAN initiated a total of 32 inventory projects during the five years from 2000 through 2004. Twenty-two of the inventory projects had been planned and approved in the 2000 *Inventory Study Plan*. The data base manager position and purchase of technical supplies were not counted as inventory projects. Since 2000, ten projects were added to the planned 22. The total of 32 inventory projects were implemented using some servicewide inventory funding. These 32 projects are listed in Table 3.

Table 3. List of inventory projects.

Project	Total # of Inventories
From Inventory Study Plan	
Data inventory (All)	1
Inventory workshop (All)	1
Vegetation mapping (GOGA/MUWO/PORE, PINN)*	2
Multi-species inventory (EUON, JOMU, PORE)	2
Herbarium assessment (GOGA/PINN/PORE)	1
Vegetation inventory (vascular plants) (JOMU)	1
Vascular plant inventory, new lands (PINN)	1
Rare plant inventory (GOGA, PORE)	2
Salt marsh harvest/Pt. Reyes jumping mouse (GOGA)	1
Bat inventory (EUON/JOMU, PORE, GOGA, PINN)	3
Small mammals/ herpetofauna inventory (PINN)	1
Riparian aquatic species inventory (PINN)	1
Coastal biological inventory, nearshore fish (GOGA/PORE)	2
Sub-tidal and deep water inventory (GOGA/PORE)	1
Bird inventory (EUON, JOMU, PINN)**	2
Sub-total	22
Accelerated from unfunded Plan needs	
Lichen inventory (PINN)	1
Hymenoptera/butterfly inventory (JOMU)	1
California freshwater shrimp inventory (GOGA/PORE)	1
Ashy storm-petrel inventory (GOGA/PORE)	1
Wetland map/inventory (GOGA, PORE)	2
Sub-total	6
Added new inventory projects	
Data mining/inventory (All)	1
Geomorphology, Strentzel canyon (JOMU)	1
Vegetation map (JOMU)	1
Soil scoping (PINN)	1
Sub-total	4
TOTAL	32

* An inventory of vegetation and vegetation mapping were initiated with partial funding by the servicewide program for FOPO, GOGA, MUWO, PORE, and the PRES in 1996 and completed within the Inventory of 2000-2004 (Schirokauer et al. 2003b).

** An inventory waterbirds/shorebirds was completed for FOPO, GOGA, MUWO, PRES and PORE with funds from the servicewide I&M program in 1997-99 (White 1999).

The SFAN initially concentrated on the vascular plants and vertebrates in order to ensure that all Network parks completed the essential inventories identified by the servicewide program. During the five-years, the Network initiated or completed development of a total of 38 taxonomic lists (see Table 4). Sixty-eight (38 of 56) percent of all taxonomic SFAN baseline data were acquired during this five-year period. Most of the surveys were in GOGA, JOMU, PINN, and PORE. Field surveys of vascular plants were conducted in two parks (JOMU, PINN). Field surveys for landbirds were conducted in six parks, for bats in five parks, for fish in two parks, and for small mammals and herpetofauna (terrestrial vertebrates) in five parks. There were ten inventories for special taxa such as lichens and invertebrates.

Table 4: Biota surveyed during the 5-year inventory program, 2000 – 2004.
An "X" represents a survey, a "P" indicates that data was available from a survey done prior to 2000 or with non-I&M funds but weren't counted for the table totals, and the shaded grey area indicates that the resource is not present in the park.

Taxa	East Bay Parks		GOGA administered						2000-2004
	EUON	JOMU	GOGA	MUWO	PRES	FOPO	PORE	PINN	Totals
Vascular plant		X	P	P	P	P	P	X	2
Vertebrate									
Bat	X	X	X	P			X	X	5
Terrestrial vert.	X	X	X	P			X	X	5
Fish			X		P		X	X	3
Bird	X	X	P	P	P	P	P	X	3
Reptile	X	X	X				X	X	5
Amphibian	X	X	X				X	X	5
sub-total of "x"	5	6	5	0	0	0	5	7	28
Non-vascular plant									
Lichen							P	X	1
Marine algae			X			X	X		3
Invertebrate									
Bee		X						P	1
Butterfly/moth		X					P	X	2
Riparian			P				P	X	1
Marine invertebrate			X				X		2
sub-total of "x"	0	2	2	0	0	1	2	3	10
Grand total of "x"	5	8	7	0	0	1	7	10	38

Accomplishments by inventory objective:

Objective 1. Compile and evaluate existing documents, specimens, and spatial information for each park into standard NPS databases, and ensure such information is accurate

1.1 Data mining

Data mining was contracted with Marsha Semenoff-Irving of the U.S. Geological Survey-Biological Resources Division (USGS-BRD), during the first year of the program. The information gathered was primarily used in the workshop to identify inventory needs and in the *SFAN Inventory Study Plan* (Press and Semenoff-Irving 2000). Compilation of existing data concerning the occurrence of the different taxa within the parks was conducted by five technicians stationed at GOGA. They visited all network parks between May and September 2000 to collect relevant information.

The Investigator's Annual Report (IAR) records for each park were examined to identify studies which had been initiated and/or completed within park legislative boundaries, in order to update citations. During the on-site visits, technicians located new reference materials and interviewed park managers and staff in order to locate additional sources of information. Searches of bookshelves, filing cabinets, and desktops resulted in over 460 new NatureBib entries. NatureBib is the national NPS bibliographic software application for citations.

Primary evidence of species occurrence included museum voucher specimen collections, photographs, research and other technical reports, and wildlife observations by acknowledged technical specialists. Evidence had to have a location within network park boundaries to be considered "present in the park". Unfortunately, during the rapid upload process, citations included species checklists and management plans which were not primary evidence of presence. Therefore, species databases needed careful review. By the end of 2000, over 430 vertebrate species and some 2,400 vascular plant species had been added to the NPS national species database, NPSpecies.

During 2003-2004, data mining was re-initiated to correct the erroneous entries, to fill specific data gaps and to expand park species lists. Six biological technicians were hired as data miners. They worked together and were supervised by Network staff in order to coordinate searches and to standardize new entries and verification of species databases. Centralization made searches more efficient, consistent, and avoided repetition by individual parks. At the beginning of each year, parks were polled for their top needs. Data miners concentrated on filling those data gaps. Their strategy was to find at minimum of one piece of evidence for each species. Therefore, the data collected wasn't comprehensive. First, the data miners developed a list of taxa with no evidence. They researched those taxa for evidence. Once evidence was located, it was recorded and they moved on to the next taxa. As a result, in order to develop comprehensive species lists, not all evidence that was available for each species was recorded. Consequently, significant evidence may be absent in the NPSpecies database for some species, particularly voucher specimens from museums.

The team of data miners started the searches by examining PORE, GOGA, and PINN park natural history collections for documentation of species presence. Working with local experts, the team found voucher specimens for biota and study reports at the following institutions: University of California Berkeley's Museum of Vertebrate Zoology, Paleontology Museum and Jepson Herbarium, California Academy of Science, University of California - Davis Bodega Marine Laboratory, College of Marin, San Francisco State University, University of California - Santa Barbara Natural History Museum, Golden Gate Raptor Observatory, PRBO Conservation Science, U.S. Geological Survey, and California Department of Fish and Game. The data mining team created several documents to help with future information searches such as a list of localities used for voucher searches and keyword tracking spreadsheets.

1.2 Data entry

Data entry was done mostly by the data miners, but also by park staff as needed. Over 33,100 pieces of evidence and the associated species were entered into NPSpecies over the five-years (Table 5 and Figure 1). One criterion was that the species had to be located within park legislative boundaries. Most of the evidence added into NPSpecies was for vascular plant species (95.6%). Two field surveys and the herbarium review were added as primary evidence for the plant species.

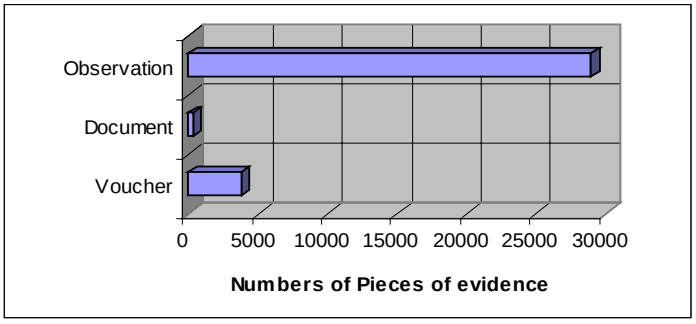
Even though the number of references added by the data miners may appear to be low, 314 is a large number of studies to discover and add. These records reported a large number of new species within the boundaries of the SFAN parks. The reports were entered into NatureBib. The most valuable primary evidence was the 3,795 voucher specimens, discovered in various institutions. The vouchers made up 11.5 % of the added evidence. In addition to documents and vouchers, field survey data and observation records were also entered. This was the largest evidence category (87.6%). All park and partner survey databases were uploaded into NPSpecies from all completed surveys conducted during the 5-year period. Data from historic databases were also entered when it was the only evidence of species presence.

Table 5. Amount of evidence in NPSpecies documenting species presence in SFAN parks.

Taxa by Park	Number of pieces of evidence in NPSpecies: Vouchers pre-2000	Vouchers post-04	Vouchers added	Records Pre-2000	Records post-04	Records added	Observations pre-2000	Observations post-04	Observations added	Total Evidence Added
Non-vasc. plants	0	104	104	1	18	17	0	0	0	121
Vasc. plants	0	3349	3349	38	135	97	650	28851	28201	31647
Invertebrates	0	3	3	3	45	42	0	39	39	84
Amphibians	1	19	18	18	35	17	0	1	1	36
Reptiles	0	16	16	13	30	17	0	4	4	37
Fish	0	84	84	17	46	29	0	186	186	299
Birds	0	141	141	96	160	64	16	556	540	745
Mammals/ bats	0	80	80	55	90	35	0	19	19	134
TOTAL			3795			318			28990	33103

Voucher = museum specimen, photograph, audio recording
Record = agency report, thesis, journal article, researcher final report, publication
Observation = NPS observation record, unpublished field notes or data from knowledgeable technical specialist

Figure 1. Type of evidence added to NPSpecies, 2001-2004.



Evidence added by park	Pre-2000	Post = Added
East Bay parks	4	500
GOGA admin. parks	757	16971
PINN	28	431
PORE	119	15201
Total	908	33103

Most of the evidence that was added was for two of the SFAN parks. PORE and the PRES had many vascular plant observations added to NPSpecies, 12,819 and 11,370 respectively. These were primarily data from field studies. The evidence for the smaller parks and PINN new lands created critical baseline data, since there had been relatively little data gathered prior to 2000. (Table 5, Appendix C)

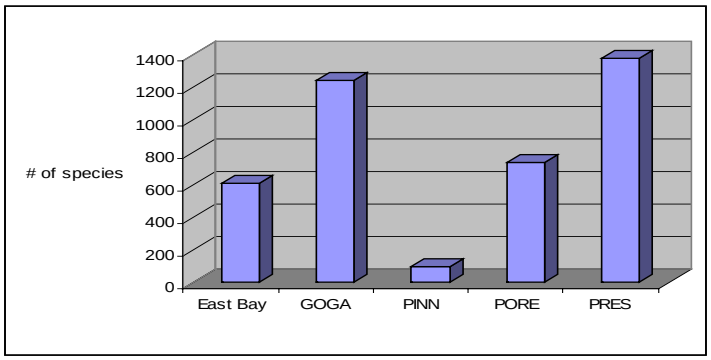
The goal to increase park species' lists was achieved. From the end of FY00 to the end of FY04, SFAN park species' lists more than doubled from 5,176 to 9,258 species. This is summarized in Figure 2 and Table 6. Almost three quarters of the additions of species to NPSpecies were vascular plant taxa (2,949 (72.7%). PRES was the recipient for the most species added. Over 90% of all vascular plant and vertebrate species listed for SFAN parks in NPSpecies now have evidence of their presence.

Table 6. Number of species in NPSpecies in SFAN parks.

Park & taxa	Number of species Pre-I&M 10/1/00	Total # added	Year 5 10/1/04
EUON			
Vasc. plants	0	200	200
Amphibians	0	1	1
Reptiles	0	5	5
Fish	0	0	0
Birds	0	51	51
Mammals	0	18	18
FOPO			
Vasc. plants	0	296	296
Amphibians	0	0	0
Reptiles	0	0	0
Fish	0	47	47
Birds	0	22	22
Mammals	0	1	1
GOGA			
Vasc. plants	1376	541	1917
Amphibians	18	4	22
Reptiles	34	9	43
Fish	32	131	163
Birds	384	80	464
Mammals	69	43	112
PINN			
Vasc. plants	641	79	720
Amphibians	13	2	15
Reptiles	29	3	32
Fish	3	3	6
Birds	155	10	165
Mammals	59	1	60
Sub-totals	2813	1547	4360

Park & taxa	Number of species Pre-I&M 10/1/00	Total # added	Year 5 10/1/04
JOMU			
Vasc. plants	341	283	624
Amphibians	0	5	5
Reptiles	0	5	5
Fish	0	1	1
Birds	76	21	97
Mammals	0	24	24
PRES			
Vasc. plants	0	958	958
Amphibians	0	17	17
Reptiles	0	28	28
Fish	0	38	38
Birds	0	293	293
Mammals	0	51	51
MUWO			
Vasc. plants	297	57	354
Amphibians	5	3	8
Reptiles	6	6	12
Fish	3	2	5
Birds	89	-1	88
Mammals	39	2	41
PORE			
Vasc. plants	922	535	1457
Amphibians	11	4	15
Reptiles	17	9	26
Fish	28	80	108
Birds	448	54	502
Mammals	81	60	141
Sub-totals	2363	2535	4898
TOTAL	5176	4082	9258

Figure 2. Number of species added to NPSpecies from 2000 through 2004 by park.



1.3 Certification

Certification of the taxonomic lists was done by park and partner specialists working with the data mining team to verify the accuracy of vascular plant and vertebrate species in the NPSpecies database. The Network used the quality assurance process developed by the servicewide I&M program to certify species accuracy. After park and Network personnel received training in January 2004, certification of the species lists was initiated. By the end of FY04, 17 park species databases were certified as accurate with documentation; by March of 2006, 38 lists were certified. Table 7 shows the number of certified park species lists by taxa. The databases that were certified can be used with certainty that the species names are accurate and that the species are actually present in the parks. When new information is obtained, a species list can be recertified. This is an iterative process, so it can be done as many times as needed. The NPSpecies database maintains records of when, who and how often a database is certified.

Table 7. SFAN Certified species lists at the end of March 2006. A date indicates when the taxonomic group was certified and the shading indicates an expectation for certification in the future.

Taxa	Date certified								#
	EUON	JOMU	PINN	PORE	FOPO	GOGA	MUWO	PRES	Certified
Vascular plants	5/12/04	5/20/04	1/5/05	3/10/06	8/31/04	3/10/06	9/28/05	6/1/04	8
Amphibians	5/25/04	5/25/04	2/18/05	6/22/05		8/30/05	5/25/04	1/22/04	7
Reptiles	4/26/04	5/25/04	2/18/05	8/30/05		8/30/05	7/12/04		6
Birds	12/8/04	12/8/04	3/4/05	6/22/05		9/29/05	9/29/05	9/29/05	7
Mammals	4/26/04	5/25/04	2/19/05	12/13/05			1/22/04	5/25/04	6
Fish			2/18/05	4/6/05	5/25/04		6/30/04		4
# Certified	5	5	6	6	2	4	6	4	38

Objective 2. Complete the documentation of 90% of vertebrate and vascular plant species in the parks through targeted field investigations and ensure that the species are accurately documented and vouchered

To achieve the documentation of 90% of the targeted species, many small surveys were conducted. Many of the inventories at GOGA and PRES that were completed between 2000 and 2005 used non-

inventory program funding (Figure 3). Therefore, the SFAN only had to fund a total of 32 inventories that were conducted. Of those that were directly supported by the SFAN inventory program, 22 of them were planned in the *Inventory Study Plan*, six were accelerated, and four were added as new projects (see Table 2). Two small parks, EUON and JOMU, would not have been able to do any biotic field surveys at all without the Natural Resource Challenge inventory funding.

Most of the field inventories concentrated on two groups, vascular plants and vertebrates. Vascular plant inventories were conducted in newly obtained parklands, in parks where this information was lacking, for rare plants, to complete vegetation mapping and for coastal resource habitat assessments. Bird data were obtained from landbird surveys in all of the parks except FOPO, and surveys for special status species such as the Ashy Storm-petrel. Other vertebrate surveys included bats at all parks and multi-species vertebrates at most of the parks.

After data gaps were identified during the workshops, strategies were examined for implementing the field surveys. Multi-disciplinary studies seemed to be the best strategy, especially for remote areas where access was difficult. The accomplishments that follow are for the inventories supported with inventory funding. Many of the other surveys are summarized in Appendix H.

2.1 Coastal biological inventory

Through this inventory, researchers identified coastal plants, marine algae, marine invertebrates, marine fish, and physical characteristics such as substrate. A cooperative agreement was developed with the University of California, Davis, in 2001. Dr. Debbie Elliott-Fisk initiated this study with a graduate student. The study design used a protocol from Glacier Bay National Park to do a rapid survey of mega-populations along the entire coastline of FOPO, GOGA, PORE, and PRES (Sharman et al. 2000). Representative transects were selected based on substrate, i.e., sand, cobble, or rock. High-resolution digital photographs were taken at each transect. Not all of the shoreline was accessible from land. Preliminary results indicated that the graduate student was able to access and survey 41.9 of the 136.9 miles of coastline (30.6%). Deliverables included a draft protocol, a relational database, field notes, photographs and a report. Data will be used as a baseline for natural resource damage assessments, biological and physical inventories, identification of rare habitats or species, and studies on coastal patterns of biodiversity. The I&M funded field survey was completed September 2004 and the final report was delivered in 2005. Completion of the survey is funded by the CDFG, oil spill program and will be finished in 2007.

The nearshore fish portion of this inventory was done through San Francisco State University. Mike McGowan initiated surveys in 2003. In 2004, the Principal Investigator was switched to Ralph Larson, since. McGowan moved to another institution. This inventory was completed in the fall of 2005; a final report is expected in 2006.

2.2 Riparian inventory

The survey was initiated in 2001 at PINN and the final report was received in 2005. Seasonal technicians were hired to assist PINN park staff conduct the field work. They concentrated on macro-invertebrates, amphibians, and fish. Key specialists identified the macro-invertebrates. Surveys for vertebrates consisted of walking all stretches of appreciable streams and recording observations of fish, aquatic amphibians, and reptiles. Invertebrates were sampled using several methods including the California Rapid Bioassessment Protocol, kick nets, dip nets, aerial sweep nets, and black light traps. Species of concern that were recorded in the park during the surveys include the federally threatened California red-legged frog, southern Pacific pond turtle (*Clemmys marmorata pallida*), endemic Pinnacles riffle beetle (*Optioservus canus*), and exotic mosquitofish (*Gambusia affinis*).

A total of nine aquatic vertebrate species were recorded at PINN, consisting of two fish, three amphibians, and three reptiles (Johnson 2005). These results indicate that the aquatic vertebrates have remained relatively unchanged over the last 40-years, with the exception of the loss of some exotic fish species and the decline of the California red-legged frog. The re-establishment of the frog has resulted in a moderate breeding population which is dispersing. The remaining exotic mosquitofish were abundant in lower Chalone Creek. This inventory is 100% complete for resident breeding species.

A total of 248 aquatic macroinvertebrate taxa were collected and identified. As an example of the diversity of aquatic invertebrates at PINN, the survey more than doubled the number of dragonflies and damselflies known to occur in San Benito County from 15 to 38. One aquatic worm new to science was discovered. High diversity of groups such as *Erimidrilus* and *Hydrophile* were an indication that the PINN aquatic ecosystem was fairly healthy. As such, it may be useful for comparison with other similar areas. This inventory has been completed.

2.3 Sub-tidal/deep water inventory

Since the boundaries of PORE and GOGA extend ¼ mile offshore and border the Gulf of Farallones National Marine Sanctuary, both parks needed some knowledge about the benthic marine habitats. The parks were working cooperatively with the National Marine Sanctuary Program (NOAA) and the California Department of Fish and Game (CDFG) as partners for this study.

The sub-tidal/deep water survey used side-scan and multi-scan sonar for benthic substrate and habitat mapping and identified species assemblages by substrate type. Moss Landing Marine Laboratory (MLML) was contracted to conduct the surveys through a consortium, the San Jose State University Foundation. NOAA and CDFG were testing sub-tidal survey methods in the region and added the parks as test sites. Surveys could only be done in calm seas, so surveys were delayed by weather and instrument availability. Surveys were initiated in 2004 and completed in 2005. Data processing and reporting is underway.

2.4 Terrestrial vertebrate inventory

One of the largest data gaps that SFAN had to address was the missing information about amphibians, reptiles, and mammals. GOGA, MUWO and PORE had previously conducted surveys to document terrestrial vertebrates in some habitats; however, these surveys were not complete. From 1990 through 1997, USGS-BRD researchers, Marsha Semenoff-Irving and Judd Howell, installed 456 ten-meter circular plots in nine different habitats in the 76,000 acres of biologically and geologically diverse park landscapes in GOGA but limited to coastal scrub and grassland habitats. The plots contained pitfall traps, Sherman live traps, track stations, and cover boards. Their results are summarized in this report to provide a complete set of baseline surveys. Gary Fellers of USGS-BRD conducted surveys at PORE between 1995 and 1999 using similar sampling methods in several habitats widely distributed within the park. MUWO was surveyed in the mid 1990s by contractors with support from NPS Natural Resource Protection Program funds.

Inventory funding was provided to complete the remaining surveys in all habitats of the parks. Gary Fellers, USGS-BRD, conducted surveys of PORE, the northern lands of GOGA, JOMU, and EUON. PINN staff conducted the surveys designed by Robert Fisher, another USGS-BRD researcher. For consistency, all surveys used the array method developed by Robert Fisher and modified by G. Fellers, using pitfall traps, Sherman traps, cover boards, and automatic cameras to capture and document the species. All surveys included incidental observations and searches through natural cover. Some surveys were initiated in PORE and GOGA in 1996-98 prior to the I&M funding, then augmented with inventory funding through 2001. JOMU and EUON were added with a task amendment to the interagency agreement in 2001 and PINN, in 2003.

The northern GOGA lands/ PORE report was received in 2002 (Fellers and Pratt). The report included a species list by habitat and capture rate (an index of abundance). Sixteen sites were surveyed representing eight of the primary habitats within the parks. Seven of the most common species that the cameras recorded were mule deer (*Odocoileus hemionus*), gray fox (*Urocyon cinerioargenteus*), raccoon (*Procyon lotor*), brush rabbit (*Sylvilagus bachmani*), bobcat (*Lynx rufus*), striped skunk (*Mephitis mephitis*), and non-native fallow deer (*Dama dama*).

During the specialized wetland surveys of seeps, springs, and streams on GOGA lands in 2003-2004, all herpetofauna encountered were documented providing additional vertebrate inventory data (Wood 2004). The California newt (*Taricha torosa*) was the most common amphibian followed by the California slender salamander (*Batrachoseps attenuatu*). Snakes and lizards were also documented.

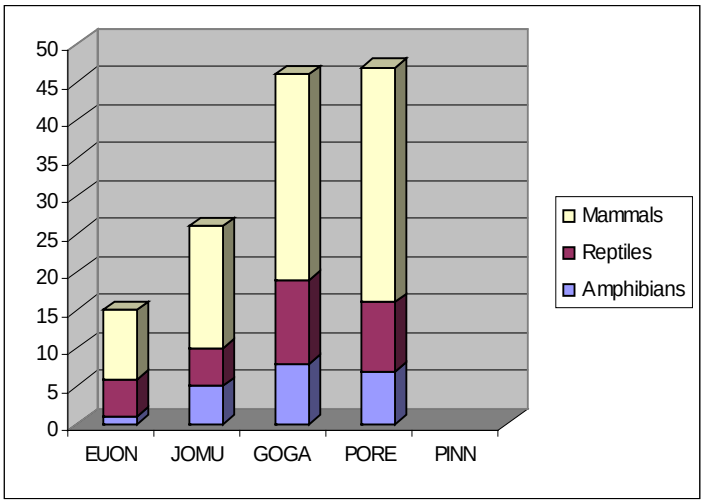
Terrestrial vertebrate inventories at JOMU and EUON were completed in April of 2003 and a final report was received in 2004 (Fellers et al.) Trailmaster cameras recorded 10 species of medium- and large-sized mammals at EUON and 12 species at JOMU. Two introduced mammals were recorded in the historic sites, the eastern fox squirrel (*Sciurus niger*) and the opossum (*Didelphis virginiana*). Birds were also photographed by the cameras at JOMU. The most interesting were the non-native wild turkey (*Meleagris gallopavo*), western screech owl (*Otus kennicottii*) and great horned owl (*Bubo virginianus*). A wide diversity of terrestrial mammals was detected. It is difficult to document the less common species, so there are species that inhabit both parks that were not included in the survey species lists.

In FY03, PINN personnel initiated the inventory of small mammals through live trapping on their new lands. Through an interagency agreement in late FY03, Robert Fisher, USGS-BRD, developed a modified sample design for the terrestrial vertebrate inventory. The park installed 14 of 20 sample arrays and started sampling in the summer of 2004. Not all areas were accessed and sampled sufficiently to complete the project in FY04. The park continued to survey for terrestrial vertebrates in order to achieve the 90% goal. This inventory was expected to be completed in FY05.

Table 8. Results of terrestrial vertebrate species added through field surveys in SFAN parks. * PINN survey results were not completed by end of FY05.

Taxa	Park:				
	EUON	JOMU	GOGA	PORE	PINN*
Amphibians	1	5	8	7	
Reptiles	5	5	11	9	
Mammals	9	16	27	31	
TOTAL	15	26	46	47	
# of arrays	1	3	2	16	20
# circular plots	0	0	456	0	
# of habitats	1	5	9	8	

Figure 3. Numbers of vertebrate species added through field surveys in SFAN parks.



In summary, by the end of FY05, all SFAN parks will have completed inventories for terrestrial mammals. The survey methods seem to be good at documenting the common species, but the rarer ones that were predicted to be present based on species range were not detected.

2.5 Vascular plants - herbarium assessment

Since herbarium collections are the backbone of vascular plant documentation and identification, an assessment of park herbariums was an early project. In 2000, SFAN contracted with EDAW, Inc., formerly KEA Environmental, to perform services to ensure that existing herbarium collections were complete and in good condition, to identify herbarium specimens, and to acquire the hardware components necessary to maintain the collections to NPS museum standards. In FY03, after the original contractor defaulted, EcoSystems West was selected to complete the work.

The contractor evaluated park herbaria for completeness. They evaluated herbarium specimen condition and labeling, recommending corrections. Then, the herbarium list was compared to the vascular plant list to determine which species were missing.

Table 9. Results of SFAN park herbariums assessment.

park	# of species on plant list	% represented by a specimen	# of plant specimens pre-2000	# of plant specimens post-2004	# of specimens collected and added
GOGA	no list	unknown	228	228	0
JOMU	no list	0%	0	470	470
PINN	573	93%	533	633	100
PORE	930	43%	399	639	240
Totals as of 2/2003			1160	1970	810

Since PORE had less than half of the vascular plants listed as present in the park represented in the herbarium collection, contractor botanists collected 240 plant species for vouchers. Even though GOGA had no viable vascular plant list, the contractor recognized that the collection was of primarily common taxa. Uncommon species are notably under represented in the collection. The GOGA

herbarium is small and needs augmentation. The PINN collection was in excellent shape with correct labeling.

JOMU received herbarium cabinets for their new working collections. Staff completed a voucher collection of plants occurring primarily on Mt. Wanda. Over 470 plant specimens were collected, identified and mounted. A working herbarium was set-up for park use and the replicate voucher collection was sent to the University of California Jepson Herbarium. Over a dozen new species were found for JOMU. Digital photos of each specimen were taken for a future "virtual herbarium". All specimens were accessioned into the museum collection and entered into ANCS+. Two interns assisted with specimen preparation, data entry, and photography.

2.6 Vascular plant field surveys

Vascular plants provide the critical structural component for ecosystems. Rare and invasive plant distribution and abundance offer special management opportunities. Field surveys were conducted in EUON, JOMU and the newly acquired lands at PINN.

NPS personnel initiated the two-year vascular plant inventory of 8,000 acres of new lands in PINN in 2002. Surveyors found twenty-seven plant species new to the park. Around 100 voucher specimens were collected for documentation. Specimen collection locations were documented using a GPS with data exported for use in GIS map creation. Metadata for the spatial data, as well as the flora database, were completed. Newly found species were added to NPSpecies. When the final report is received at the end of FY05, more accurate numbers and results can be reported.

Since Port Chicago National Monument (POCH) was administered by the EUON/JOMU group and it has a natural shoreline, it was added to the vascular plant survey. All East Bay units were surveyed by Eric Jepson and Andrew Murdock of PRBO in 2002. A total of 468 vascular plant species were documented for the three park units (Jepson and Murdock 2002). As transects were walked, new plants observed were added to the list. Data from the 1992 plant survey (Hunter et al. 1993) was included in this survey to create the baseline. Habitat descriptions were based on the Hunter survey. Only 55% of the plants that were encountered during the surveys were native to California. These were found in more selective, undisturbed habitats such as the mixed evergreen forest, chaparral, and blue oak woodland. All data from the inventory were entered into NPSpecies by NPS staff.

An inventory of non-native vascular plants in JOMU was added as a subset of the vascular plant inventory to obtain distribution and abundance of specific taxa for park management and for the Central Coast Exotic Plant Management Team. It was accelerated out of the unfunded needs category of projects in the *Inventory Study Plan*. Since Susan O'Neil, the Network Biological Technician working with the East Bay parks, was a botanist, she led the project using interns and volunteers as field assistants. Seven non-native plant species were selected. The perimeters of over 100 separate patches of these specific invasive species were mapped using a GPS and then entered into a GIS.

During the vascular plant survey in oak-dominated habitats at JOMU, park staff observed few oak saplings. Since the lack of regeneration is a serious threat to the long-term health and viability of oak woodlands throughout California, a mini-inventory was initiated. The goal was to develop the reference data for oak regeneration and condition monitoring on Mt. Wanda. In 2004, 26 transects were established within the oak-dominated vegetation types. Plenty of seedlings were encountered, but there is a bottleneck. No oak saplings were discovered in any transects (O'Neil 2002).

2.7 Landbird inventory

All parks in the SFAN needed more complete bird data. Surveys started in FOPO, GOGA, MUWO, PORE, and PRES prior to the Natural Resource Challenge funding. The other parks were surveyed using I&M inventory funding. No systematic surveys had been done in the small East Bay parks (EUON, JOMU). PINN had a bird checklist but lacked information for the newly acquired lands. Since PRBO Conservation Science had conducted the previous studies of the landbirds prior to 2000, they were selected to do the needed surveys for data comparability across the Network through a cooperative agreement. PRBO Conservation Science surveyed breeding landbirds in 1999-2000 at GOGA and PORE and in 2001 at JOMU and in 2001-2002 at PINN.

Standardized point count census stations were established in all of the parks. At PRES and PINN, variable point count stations were used. At all other parks, fixed-radius point count stations were used. Point count stations were spaced 200-250 m apart along linear transects. At each station, a 5-minute, 50-meter census was conducted. In most locations, stations were surveyed three times a year for two or more years. During the breeding season, they were surveyed multiple times. At PINN, a winter bird survey was conducted in addition to the breeding season survey because there was incomplete information on this seasonal usage at the park.

The MUWO surveys in 1997-99 (Gardali and Geupel 2000) were set up to document birds along two trails and 15 off-trail sites. The highest diversity and species richness were on the Bootjack Trail, followed by the off-trail points, and the Ben Johnson Trail. The Pacific-slope flycatcher (*Empidonax difficilis*) and winter wren (*Troglodytes troglodytes*) were the most abundant species encountered.

A total of 131 bird species were recorded in GOGA, PORE, and PRES (Flannery et al. 2001). Only one landbird species, the song sparrow (*Melospiza melodia*), was detected in all habitats within the three parks. Seven species of birds were detected in all habitats except the dune sagewort habitat: Allen's Hummingbird (*Selasphorus sasin*), Bewick's Wren (*Thryomanes bewickii*), California Towhee (*Pipilo crissalis*), Purple Finch (*Carpodacus purpureus*), Spotted Towhee (*P. maculates*), and Wilson's Warbler (*Wilsonia pusilla*). Of the thirteen habitats that were surveyed, red alder, bishop pine, and Monterey pine habitats had the highest diversity and species richness. Coast live oak had the highest bird abundance. Low diversity, richness, and abundance were found in grassland and dune sagewort.

The Network Biological Technician created a database for JOMU birds, incorporating the 47 species of birds that PRBO Conservation Science documented in their surveys (Hammond and Geupel 2003) with the observations by a park naturalist, Cheryl Abel. The result was a more robust list of birds which better reflected park resident, migrant and nesting species. This list was entered into NPSpecies and certified in 2005 for JOMU.

Three habitats were surveyed at PINN from 2001-2002 (Haff et al. 2003). The riparian habitat had the highest diversity of bird species (11.7 species) followed by the pine-oak woodland. Chaparral had the lowest diversity, richness and total number of species. The most common species in the park were Black-headed Grosbeak (*Pheucticus melanocephalus*), House Wren (*Troglodytes aedon*), Nuttall's Woodpecker (*Picoides nuttallii*), Song Sparrow, and Warbling Vireo (*Vireo gilvus*).

The total number of bird species documented during the breeding season surveys was 90 species in GOGA, 47 in JOMU, 99 in PINN, and 111 in PORE (Humple and Gardali 2004, Haff et al 2003, Hammond and Geupel 2003). Three bird species, Bewick's Wren, California Quail (*Callipepla californica*), and Mourning Dove (*Zenaida macroura*), were encountered in all survey locations in all parks.

The final landbird survey reports were accepted in 2004, the data was received in 2005. Table 10 summarizes the results of the surveys based on the data in the reports. A total of 349 permanent point count stations were established for the inventories. Selected stations can be monitored long-term for the landbird vital signs indicator. Since the point count method relies heavily on detecting birds by sound, it is best for surveying songbirds with relatively small, fixed territories during the breeding season. Therefore, migratory and winter landbirds were under represented.

Table 10. Effort and results of the SFAN landbird surveys, 1998-2003.

Park	# point count stations	# bird species
EUON	5	50
GOGA	91	90
JOMU	14	47
MUWO	45	75
PINN	92	99
PORE	78	111
PRES	24	61

2.8 Bat inventory

Because bats are nocturnal and often roost in cryptic inaccessible locations, they are difficult to study in the wild. Surveying bats involves very different methods from other mammal species, including use of an acoustic bat detector (Anabat, trade name) that records their echolocations. Software lowers the sound signatures from their high pitch into the human range of hearing. Researchers can then identify what species are present. The digital recording is conducted continuously over a period of a year, so that seasonal data are also provided on migratory species. The digital recording is primary evidence of species presence, as is a photograph or a voucher specimen.

The first bat surveys were done in MUWO, initiated in 1999 through a contract to Paul Heady with non-inventory funding. Inventory funding was used for the other park surveys. Bat surveys in PORE, JOMU, GOGA and EUON were initiated in 2002 through an interagency agreement with Gary Fellers of USGS-BRD. The bat survey at PINN was contracted in 2001, but the individual defaulted. The contract was re-awarded to Paul Heady in 2004 and the study and report was completed in 2005.

The number of bats detected by the two investigators is similar despite some differences in the methods that were used. The MUWO used guano traps and both MUWO and PINN studies used mist netting in addition to acoustic sampling. The bat surveys conducted in the remaining parks were by acoustic sampling alone (Fellers 2002, Fellers 2003). The ten bats detected at MUWO represent 63% of the bats expected in this portion of coastal California based on species range maps (Heady and Frick 2004).

Table 11. Effort and results of the SFAN bat inventories, 1999-2005. The number of stations at MUWO refers to guano traps. All other stations refer to acoustic stations.

park	# of stations	# of species
EUON	1	9
GOGA	1	9
JOMU	1	9
MUWO	26	10
PINN	8	16

park	# of stations	# of species
PORE	8	9

Objective 3. Inventory taxa of special interest identified in the Network's Inventory Study Plan and develop spatial distribution maps and estimates of abundance or condition

The Network determined that several groups of taxa required more intensive inventories with distribution maps and estimates of relative abundance. These groups included threatened, endangered and rare species that may require particular protective strategies, non-native species that may require control actions, and lichens which may become a vital sign indicator.

3.1 Rare plant inventory

Surveyors in this field inventory searched for federal or California listed plant species, endemic plants, and rare plants in sensitive habitats. Inventory funding was mostly used for surveys at GOGA and PORE. These parks have a great biodiversity at risk. They needed to know the locations and relative abundance of these rare plants since many grow close to urban interfaces and trails where they may be disturbed by park activities or occur on steep slopes that may erode. For other parks, rare plant surveys weren't as great a need or they had staff that could do some surveys where needed.

The inventory of rare plants for PORE and GOGA was initiated in FY01 and was completed in 2004. The SFAN Natural Resource Specialist, working with the Vegetation Working Group, utilized some of this new information to develop monitoring plans and protocols for several of federally listed species.

Table 12. Results of SFAN rare plant surveys, 2001-2004.

Park	Estimated # of acres surveyed	Total at end of 2004		New to park:	
		# of species	# of known pop.	# of new species	# of new pop.
GOGA	4238	33	190	7	101
PORE	4346	31	438	3	148
Total	8584	64	628	10	249

The PORE inventory effort resulted in a large volume of information describing the abundance and distribution of the Seashore's rare plant species, and has been critical in managing cattle grazing permits and protecting populations. A total of 148 previously unrecorded rare plant populations were documented and mapped (Coppoletta and Skaer 2004). This increased the total number of known rare plant populations by 34%. In addition, 3 new rare species were discovered. Over 2,300 volunteer hours contributed to this park-wide effort.

Experts conducted searches at GOGA. By the end of FY03, eighteen populations were documented in the fifteen areas that were surveyed. Reports were submitted in 2002 and 2003, and include detailed maps and inventory information (Faden 2003, Taylor 2003, Holloran 2002). The final report is pending.

Using non-inventory funding, PRES resource staff and volunteers visited over 70 rare plant populations. Data were collected documenting population size, habitat characteristics, current land use practices, and overall site quality. All populations visited were evaluated for existing and potential threats. Presidio stewardship staff performed annual demographic monitoring of the endangered Presidio or Raven's manzanita (*Arctostaphylos hookerii* spp. *ravenii*), the only known population of this species. GIS maps from previous years were ground-truthed for some species and plant occurrence boundaries were adjusted.

3.2 Lichen inventory

Lichen diversity was of interest to PINN park staff as a potential vital signs indicator for monitoring air pollutants and because PINN already had one known endangered lichen. It was initiated in 2003 by Shelly Benson, a lichenologist working at PORE. Through data mining, she uncovered 241 specimens that were collected from within park boundaries. During the field survey, she collected 419 specimens. This effort more than doubled the previous lichen list for the park which now stands at 293 species. She and four different California lichen experts identified specimens. Twenty-one of the species were rare in California and 129 were first recordings of the species for PINN. Four new occurrences of *Texosporium sancti-jacobi* (TESA) were found as a result of the inventory. There are now eight known occurrences of TESA at PINN. TESA is listed as critically endangered on the Global Red List of endangered species. This inventory was completed.

3.3 California freshwater shrimp inventory

The California freshwater shrimp (*Syncaris pacifica*) is endemic to sixteen coastal streams in Marin, Sonoma, and Napa counties north of San Francisco Bay. It is listed as federally endangered and is the only extant member of the genus. The shrimp is found in low elevation (<116 meters), low gradient (<1 percent), perennial freshwater streams where banks are structurally diverse with undercut banks, exposed roots, overhanging woody debris, or overhanging vegetation. Habitat degradation, introduced fish, water pollution, and flood control activities are primary reasons for decreasing populations.

Since biologists agree that the presence of the shrimp is an indicator of good stream condition, baseline data was important for the development of the monitoring plan as well as protection of the shrimp and its habitat. Therefore, this baseline survey was implemented using monitoring funding. NPS personnel, Darren Fong and Ro LoBianco, completed field sampling during the summer and early fall of 2002 in GOGA and PORE. Of the thirteen creeks surveyed, seven shrimp were found in Olema Creek only. The final report summarized survey locations, stream habitat conditions, and presence/absence of the shrimp and other aquatic organisms (crustaceans, mussels, fish, and macro-invertebrates; LoBianco and Fong 2002). The report included recommendations for future surveys and management actions needed to enhance suitable shrimp habitat. This inventory was completed.

3.4 Terrestrial invertebrate inventory

Invertebrates**,** especially plant pollinators, are generally an under-studied group. Bees are an essential component of biodiversity since they are primary pollinators of non-wind pollinated plants. Terry Griswold, USDA Bee Lab, developed baseline Hymenoptera data for PINN and JOMU. The PINN study was done without inventory funding in 1997 and documented 310 bee species representing 52 genera. The 1997 survey nearly doubled the total collected bee fauna at PINN, adding 139 species to the previously known list. Thirteen of the species were undescribed and there were several range extensions.

The JOMU study was conducted from mid-March 2002 through late September 2002 on Mt. Wanda. A total of 70 species were collected in JOMU, representing 26 genera (Griswold et al. 2005). Forty-six percent of all species collected were from plants in the Aster family. Each bee species visited an

average of three plants. Five genera of plants attracted a diverse number of bee species – *Carduus, Centaurea, Holocapha, Madia,* and *Silybum*.

NPS staff initiated a butterfly and moth inventory for JOMU with funds from the Pacific West Region. Susan O'Neil, SFAN Natural Resource Specialist, obtained assistance from the North American Butterfly Association and the PINN aquatic biologist to conduct a survey in 2003 and 2004. The report will be prepared after specialists complete the identification of difficult species.

3.5 Tidewater goby survey

The tidewater goby (*Eucyclogobius newberryi*) is a small benthic fish found in slightly brackish coastal waters. It is estimated that the goby disappeared from nearly 50% of the coastal lagoons due to the introduction of non-native fish and habitat degradation. It was listed as endangered in 1994 by the U.S. Fish and Wildlife Service. Historic records indicated that the goby was last observed in 1953 in Lagunitas Creek, which feeds into Tomales Bay.

The intent of the 2002-2003 survey was to identify potentially suitable habitat for tidewater gobies along the shoreline of Tomales Bay in GOGA and PORE and to determine the presence or absence of the goby in these habitats. In so doing, project data would provide baseline fisheries data for this area. Maps were used to identify shallow embayments and sloughs that were fed by streams that probably had brackish water. The Tomasini Creek population represented the only remaining population of the gobies. For all the surveyed sites, a total of eleven fish species were identified. Threespine stickleback (*Gasterosteus aculeatus*) was the most frequently encountered fish both in terms of relative abundance and in distribution (Fong et al. 2004). Highest fish densities were encountered at Borello Ranch and Tomasini Creek. Two non-native fish species, Western mosquitofish and yellow fin gobies (*Acanthogobius flavimanus*), were documented. They are introduced species as was the European green crab (*Carcinus maenas*). Macrocrustaceans, reptiles and amphibians, mostly tree frogs (*Pseudacris regilla*), were also documented. This inventory was completed.

3.6 Ashy Storm-petrel inventory

Ashy Storm-petrels (*Oceanodroma homochroa)* are a federal species of special concern that occur in only a few places in the world. Ten percent of the world population is estimated to occur at PORE. In FY01, a cooperative agreement with Humboldt State University Foundation was signed to inventory the petrels at GOGA and PORE. From surveys conducted in FY02 at three breeding locations in PORE, researchers estimated PORE had 30 to 50 breeding pairs (Whitworth et al. 2002). Two new colonies of this petrel were discovered; however, the original colony appeared abandoned. No nesting sites were located at GOGA. The new colonies represent long established colonies which had not been detected due to a lack of adequate survey efforts. A final report was accepted by SFAN staff in FY03. The GIS layer of the nesting locations was developed in FY04 to complete the project.

3.7 Waterbird and shorebird inventory

PRBO Conservation Science completed a winter survey of waterbirds and shorebirds in the four coastal parks (GOGA, PORE, FOPO, and PRES) between 1998 and 1999 (White 1999) with servicewide I&M funding. GOGA staff and interns completed additional surveys from 2000 through 2002 (Dybala 2002, Osbourne 2001), and USFWS conducted surveys between 2000 and 2003 at PORE. Together they provide a more complete picture of these guilds. The highest species richness was in Bolinas Lagoon and Drake's Estero. The most common bird was the Ruddy Duck (*Oxyura jamaicensis)* followed by American Widgeon (*Anas americana*), Dunlin (*Calidris alpine*), Bufflehead (*Bucephala albeola*), Least Sandpiper (*Calidris minutilla*), Western Sandpiper (*Calidris mauri*), and Marbled Godwit (*Limosa fedoa*). Of note at the GOGA sites were the large number of Western Grebes

(*Aechmophorus occidentalis*) at FOPO in late February 1999. Brandt's Cormorants (*Phalacrocorax penicillatus*) and Least Terns (*Sterna antillarum*) were common on the FOPO pier.

3.8 Salt marsh harvest mouse and Point Reyes jumping mouse inventory

The salt marsh harvest mouse (*Reithrodontomys raviventris*) is a federally listed endangered species and the Point Reyes jumping mouse (*Zapus trinotatus orarius*) is a federal species of concern. Both are known to occur in GOGA and PORE, but the distribution is unknown. In 2002, John Takekawa, USGS-BRD scientist, completed small mammal surveys at Big Lagoon (GOGA) targeting these taxa. Five different habitat types were surveyed during the fall. Even though the targeted species were not caught, four species were captured. The western harvest mouse (*R. megalotis*) accounted for nearly 83% of all captures (Takekawa 2003). Most mammals were found in the pasture and wetland areas, with their presence related to vegetative cover, not vegetative height. The information provides a needed baseline for restoration activities within the watershed. Other appropriate habitats in PORE and GOGA still need to be surveyed. The survey at Big Lagoon was completed.

Objective 4. Complete baseline vegetation mapping for the Network

Plant communities are a fundamental component of the biological community; therefore, the Network chose to accelerate vegetation mapping for all parks. Since vegetation maps are critical pieces of information used by parks for planning, mitigation, restoration, monitoring, and inventories, they were accelerated from planned schedules to be started by 2004.

4.1 Vegetation maps

Three land cover map projects were undertaken. The largest project was the plant community classification and mapping project for five park units (FOPO, GOGA, MUWO, PORE, and PRES). It progressed in spurts after initiation in 1995 with the purchase of aerial photographs. Funding for the map was provided by the servicewide I&M program, the Fire Management Program, the California State Parks and Recreation, PORE and GOGA. Several contractors and sub-contractors were involved including the Environmental Systems Research Institute (ESRI) who developed the digital map. NPS and USGS vegetation mapping standards were used. GIS staff at PORE finished the accuracy assessment of the vegetation map in 2003. Eighty-seven plant communities were described using 366 vegetation sample plots (Schirokauer et al. 2003b). Overall thematic accuracy varied from 44% at the plant association level, the lowest hierarchical level, to 87% at the highest level, the life form. Contract deliverables included digital hardcopy and digital vegetation map, plant community descriptions, field key to the plant communities, an accuracy assessment report, a final project report, field data sheets and metadata. The protocol for vegetation mapping and characterization has been refined through this project. The project was completed.

The existing vegetation map for PINN was twenty years old. Since then, the park acquired 8,000 acres of adjacent BLM land. The existing map was inaccurate due to regrowth after multiple wildland fires; therefore, the park needed a new map covering the entire park. PINN started with an inventory of the vascular plants of the new lands, which was completed in 2003. Since the standard classification for California did not meet their needs, scientists from the California Native Plant Society and NatureServe will assist the park with the development of a vegetation classification key for the vegetation map. The University of Montana Wildlife Spatial Analysis Laboratory was contracted to produce the vegetation map using IKONOS digital data that the park obtained in 2000. The park is verifying the accuracy of the draft map using relevés of vegetation plots in the 28 vegetation communities identified in the draft map. This project will be completed in 2006.

In order to complete vegetation mapping of all larger areas with natural resources in JOMU, the SFAN undertook a small, one-year project to develop the land cover map for Mt. Wanda in 2004. Visual interpretation of two aerial photographs was field-tested using the rapid assessment method. A total of 13 plant alliances and 18 plant associations were identified and mapped (O'Neil and Egan 2004).

Table 13. Results of SFAN land cover mapping, 1994 – 2004.

Park	# of acres	# of vegetation communities (associations)
JOMU	325	18
PINN	24,000	28
GOGA/ PORE/MUWO/FOPO/PRES	155,000	87

4.2 Wetland mapping

Wetlands are an important component of park natural resources planning due to their protected status. Wetlands are ecologically significant and were ranked 15th in the prioritized list of vital signs monitoring indicators. The Network undertook two wetlands mapping projects. Each project had a different need and objective.

After testing the accuracy of the US Fish & Wildlife Service National Wetland Inventory (NWI) map for omission errors, the PORE GIS Biologist led the effort to map wetlands for PORE using a fine scale resolution (Schirokauer et al. 2003a). The NWI minimum mapping unit was 3 acres. PORE used approximately 10 square meters for dune swales where there were rare plant populations and 404 square meters or 1/10th of an acre for most other areas. At least 53% of the wetlands were not delineated on the NWI map because of errors of scale and film processing. Small wetland areas, important to species richness and rare species, were missed. Abbott's Lagoon was used for the pilot enhanced mapping project. Over 911 acres within 230 wetland units (polygons) were inventoried and mapped. PORE acquired funds from the NPS-WRD to map wetlands in Tomales Bay.

GOGA desired data about specialized wetlands used by amphibians. Survey sites were located in 2003-2004 based on vegetation types: seeps, springs, and streams. The California red-legged frog, a federally threatened species, has critical habitat in the park. All herpetofauna encountered were documented providing additional vertebrate inventory data mentioned in Section 2.4. Physical data gathered included the water regime, the distribution of Cowardin wetland types, and hydro-geomorphic features (landform, hydrodynamics, and water source; Cowardin et al. 1979). To date, 159 seeps and springs have been located on GOGA park lands in Marin County. Data analysis and report writing are still underway.

Objective 5. Complete abiotic inventories

Two of the abiotic inventories supported by the SFAN I&M program were field surveys and one, the soil survey, was a workshop to share information. All three projects were added because of need and were not originally in the *Inventory Study Plan*.

5.1 Geomorphic survey of Strentzel Canyon

Areas downstream of this canyon on Mt. Wanda, JOMU, annually face the possibility of large rainfall events that could wash sediment and debris into adjacent homes. Due to potential lawsuits, JOMU made this project its number one priority. The park started this project by supporting the salary of a physical scientist from PINN. Cross-channel surveys were initiated in 2003. Results from this study

will be added to the Alhambra Creek Watershed Management Plan. The study will be completed in 2005.

5.2 Soil surveys
Most of the Soil Conservation Service (now the Natural Resource Conservation Service) county soil maps were done several decades ago, so most are in the process of being updated. For example, PINN uses two soil maps. The San Benito County soil survey was done in 1969 using a non-rectified 1958 photo-base. PINN only has two soil types represented in this survey. The Montecito County soil survey was done in 1978 at 1:24,000 using a 1972 photo base and is better. The NPS has a national Memorandum of Understanding with the Natural Resource Conservation Service (NRCS) and a state level Interagency Agreement. The highest priority for the Network is to get another soil survey for PINN, then for JOMU. This was expressed to the NRCS during a meeting in September 2002. The NPS National Soil Scientist, Pete Biggam, will help develop appropriate survey and mapping parameters.

5.3 Weather station locations
Weather and climate were ranked by the network as the highest priority vital sign to monitor because the information gathered is basic and critical for all other vital signs and research. In order to understand and interpret weather and climate, it is important to know where the data gathering occurs. Therefore, an inventory of the weather stations in the SFAN area was completed to compile existing information. Both fixed and non-permanent weather stations were located. The report has several helpful lists divided into permanent and non-permanent park weather monitoring stations and National Climate Data Center (NCDC) weather stations (De Blasi 2005). Over 130 NCDC stations within 50 miles of FOPO and PINN were added to the list, allowing parks to determine which stations would provide useful data. In addition to station names and locations, the period of record, and recorded parameters (e.g., temperature, precipitation) were added. There are eight permanent monitoring stations in the parks; one in EUON, one in GOGA, three in PINN, and three in PORE. In addition, parks have temporary stations that can be established to monitor weather "events".

Objective 6. Coordinate with other natural resource studies

To expand knowledge and resource conservation beyond park boundaries, the SFAN program contacted representatives working on state, regional and national programs in order to exchange information.

6.1 The Tomales Bay Biodiversity Inventory (TBBI)
The TBBI is an example of a community based inventory program in which the SFAN are participants. The TBBI was one of many objectives of the Tomales Bay Watershed Council, a partnership to preserve, protect and restore the ecological integrity of Tomales Bay, to form a foundation for scientific inquiry and public policy to address threats to the bay, and to raise public consciousness on effective stewardship of coastal lands. Since Tomales Bay is within the boundaries of GOGA and PORE, both SFAN parks will benefit from the knowledge that is gathered and the collaborative partnerships that are formed. In 2002, the United Nations designated Tomales Bay for inclusion in the Ramsar List of Wetlands of International Importance. The TBBI, initiated in 1999, is an all species inventory modeled after the Great Smoky Mountains National Park ATBI.

The TBBI is augmenting and integrating information, methods and data with the SFAN I&M program but is completely funded from other sources. Ben Becker, the Pacific Coast Science and Learning Center (PCSLC) Director, is facilitating the inventories by providing guidance, assisting with logistics,

and contributing access to facilities and boats. The PCSLC supported a data manager to synthesize inventory data into a single system and to link it to a web site (Tomalesbaylife.org).

Program objectives include the following:

- Complete a comprehensive checklist of life forms in Tomales Bay
- Consolidate existing and new information into a single database with GIS
- Conduct an inventory of biological taxa including:
    - Plankton
    - Benthic and intertidal organisms
    - Vascular and non-vascular plants
    - Fish
    - Mammals and birds
- Create distribution maps for species of interest (e.g. rare, abundant or non-native).
- Synthesize information and provide to scientists, educators, land managers and all other interested parties.

With support from the Mead Foundation, Cox Family Fund, the Marin Community Foundation, and the NPS, one of the most comprehensive marine biodiversity surveys in the world was initiated. An estimated 10,000 species are living in the Bay, yet scientists know less than a quarter of them. Taxonomists from universities and high schools converged on Tomales Bay for intensive bioquest surveys. A bioquest survey is a rapid inventory, involving many people working over a short time period to conduct surveys of specific taxa or taxa groups. Species that have been surveyed include plankton, intertidal invertebrates, fish, algae, rare plants, tunicates, waterbirds and shorebirds. Multiple bioquest surveys have been conducted through partnerships with the University of California and California State University systems, Tomales Bay High School, Stanford University, Natural History Museum of Los Angeles County, Dominican University, University of Oregon, and Los Angeles Marine Biology Lab, and Hydrozoologica. Over 2,000 species have been documented and catalogued in the program database.

6.2 NOAA National Marine Sanctuaries Program

The relationship between the Network and the NOAA Sanctuaries Program is an example of a different type of effective partnership. The NPS has coordinated with NOAA to inventory shared resources in the marine realm. The boundaries of GOGA and PORE are shared with the Gulf of the Farallones, Monterey Bay and Cordell Bank Marine Sanctuaries. Projects included in this joint venture were the sub-tidal inventory using side-scan and multi-beam sonar. This joint survey will continue over the next couple of years until completion. In addition, SFAN is collaborating and sharing data for two vital signs, rocky intertidal monitoring, pinniped monitoring and seabird monitoring. This helps the network expand the spatial knowledge base and analysis. Database sharing was made possible due to the creative use of a shared position between the NPS and NOAA.

6.3 Alhambra Creek Alliance

The Alliance is an East Bay partnership in which JOMU actively participates. The goal is to improve the quality of the Creek. The Alhambra Creek watershed covers approximately 16.5 square miles of Coast Range foothills. The Creek drains past JOMU, through the City of Martinez and out into the Carquinez Strait joining the waters of San Francisco Bay. There are three reaches of the Creek system, two of which flow beside JOMU. Most of the land use in the watershed is unpaved land, but that is rapidly changing as residential development expands.

Beginning in 1997, the stakeholders, people who reside in the watershed, identified issues and developed a working group to recommend solutions through a Watershed Management Plan. Concerns and issues include reduction of flood damage and erosion, development of baseline water quality conditions and overall improvement of Creek water quality, development of sustainable land uses, and restoration of fish and wildlife habitat. The Strentzel Creek geomorphology inventory that the NPS is completing will be used by the Alliance to develop recommended stabilization and erosion control.

Objective 7. Implement strategies to share and protect inventory information

A primary purpose of the Inventory Program is to make data and information available to park management for decision-making, to park technical specialists for assessments, comparisons and evaluation, and to the public. At the beginning of the program in 2001, the Inventory Coordinator described the program and goals to each park Superintendent and their staff. As a follow-up in 2003, the Inventory Coordinator presented annual results to the park staff and Superintendents. The 5-year program results were presented in 2005 to the Superintendent and Chief of Resource Management of each park.

7.1 Database management

Processes were initiated to ensure the quality, security, longevity, and availability of natural resource inventory data. These data are the vital building blocks for ecological understanding about park resources. The data must be accompanied with sufficient context about how and why it was collected to maintain its value beyond the lifetimes of those who collected it. A Data Management Plan is being written by the lead park data manager to describe this process and the important participants.

The term “data” encompasses more than the numerical tabular information and fall into five general categories:

- Raw data. Examples include raw field forms and notebooks, photographs, biological voucher specimens, and sound recordings.
- Compiled/derived data. Examples include relational databases (MSAccess preferred), tabular data files (Lotus preferred), GIS layers (ArcView preferred), and species checklists (NPSpecies).
- Documentation. Examples include data collection and data processing protocols, metadata, and quality assurance report.
- Reports. Examples include annual progress reports, final reports, publications, and white papers.
- Administrative records. Examples include contracts and agreements, work plans, research permits, and budgets.

Four of the national data management applications were used by the SFAN inventory program:
NatureBib is the master database for bibliographic references. It contains citation data and an abstract. NatureBib currently focuses on natural resource references, but may eventually be linked to references on cultural resources and other park operations.
NPSpecies is the master species database for the NPS. The database lists the species that occur in or near each park and the documented evidence for the occurrence of the species (vouchers and observations).

NPSpecies is linked to NatureBib for references that are the written evidence of occurrence. Taxonomy and nomenclature are based on the ITIS (interagency Integrated Taxonomic Information

System). The master version is maintained from Ft. Collins on the internet and is in active development as the biological inventories submit data. The password protected master version was available to NPS employees and cooperators. From a past upload from NPFlora and NPFauna, the database contained duplicate records, outdated species names, and various errors. Therefore, it required revision and certification before any data will be available to the public.

DataSet Catalog is a desktop metadata application developed by the I&M program to provide a tool for management of data holdings. It is used for cataloging abbreviated metadata about a variety of digital and non-digital natural resource datasets. It was designed to meet Executive Order 12906 mandating federal agencies to document all data collected after January 1995.
GIS Theme Manager is an ArcView or ArcGIS extension than can be used as a stand-alone application as a means of organizing and displaying integrated natural resource information. Fully FGDC-compliant metadata for spatial information can be developed through this application.

Figure 4. Flow chart for SFAN data management.

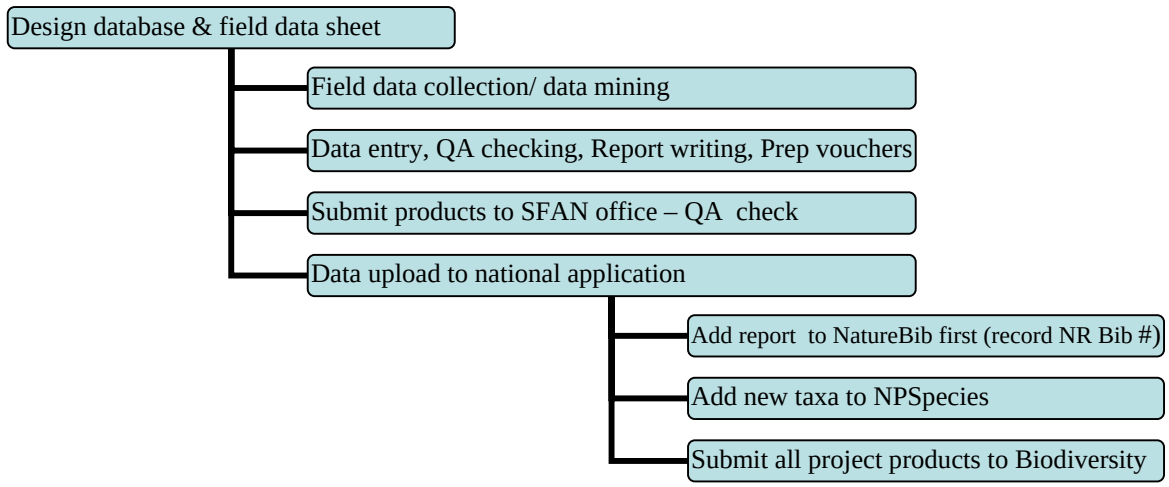


Figure 4 shows the different stages of data management where quality assurance was used. It began with the design of the database and data entry forms and ended with the archiving of the data.

The SFAN parks understand that the data resulting from the inventories is a valuable resource worthy of preservation. This is justified only if the data can be used with confidence. Data of poor quality can result in loss of sensitivity and incorrect interpretations and conclusions. Therefore, the most important goal for the SFAN I&M data management program is to ensure that the data is of the highest possible quality. The NPS Director's Order #11B: Ensuring Quality of Information Disseminated by the National Park Service was issued in 2002 to ensure and maximize the quality of information used by and disseminated by the NPS. The term "quality" is defined to comprise objectivity, utility, and integrity. Objectivity includes the accuracy of data presentation (clear, complete, and unbiased) and the substance of the data (accurate and reliable). Utility refers to the usefulness of the information for both the NPS and the public. Integrity refers to the security of the information from unauthorized access or revision to ensure that it is not compromised through corruption or falsification.

The SFAN Data Management Plan addresses quality assurance procedures to maintain good quality at all stages of a project. It was developed towards the end of most inventory projects; therefore the Plan documents the best of the data management procedures used by the parks and those required by the servicewide program. The NPSpecies application has developed a quality assurance process for the data that is entered as part of the certification process.

7.2 Data dissemination

The SFAN's main mechanism for distribution of the inventory data will be the internet. This will allow the data to reach a broad community of users. The servicewide I&M program has developed several applications and repositories to distribute data:

- NatureBib
- NPSpecies
- Biodiversity Data Store - This is a digital archive of documents, GIS datasets, and non-spatial datasets. The servicewide Inventory Program created the Biodiversity Store in 2004. As each inventory was completed, all products obtained from the inventory were submitted to the data store, which is an archive location for each inventory. The public will have access to it in the fall of 2005 (www.science.nature.nps.gov/im/inventory/biology/index.htm)
- SFAN website - In 2002, the SFAN developed a website (www1.nature.nps.gov/im/units/sfan/) make available to park staff and the public the final reports and programmatic information. In 2003, completed inventory reports were added to the website. Data and products will either be available through this site or users will be directed to another location, such as the Biodiversity Datastore.

Not all data developed by the inventory program will be made accessible to the public or other parks. The NPS is directed to protect information about the nature and location of sensitive park resources under the following orders and laws:

- Executive Order No. 13007 and Director's Order #66, Indian sacred sites
- National Parks Omnibus Management Act (16 U.S.C. 5937)
- Federal Cave Resources Protection Act (16 U.S.C.4304)

Through these regulations, information that could result in harm to natural resources, including endangered or threatened species, will be classified as "protected" and may be withheld from public release. The SFAN inventory program currently protects information about locations of selected rare plants, lichens, and other taxa when the populations need special protection.

Inventory information was shared through a variety of formats:

- Presentations. Park staff made presentations to academic institutions and scientific workshops about their inventories. As a project deliverable for each contract and agreement, the researcher had to give a presentation summarizing their project results in a 1-hour presentation to park staff at the end of their project
- Articles. Some inventory leads submit articles to peer-reviewed journals about their project.
- Other written material. At times inventory information was used in park brochures, planning documents, and environmental assessments.
- Public involvement. Parks involved the public through their volunteer programs. Many of the inventories also used college interns to gain job experience and college credits. One program, the PORE Rare-Plant-A-Thon, became so popular that it will be continued in some form after the formal inventory was completed in 2004. The TBBI paired high school science interns with scientists.
- Website.

7.3 Data archiving

All data for each project are maintained by the park I&M Coordinators at the park for use by the parks. Hardcopies of reports and digital copies of compiled/derived data, documentation, reports, and administrative records are also maintained in the SFAN office. The SFAN places important documents and final reports on their website. As mentioned above, final archiving of inventory products is in the Biodiversity Store. This redundancy is important to prevent loss of important information.

Important hardcopy reports will also be maintained in several museum archives. The PORE archivist will maintain reports from PORE and from the East Bay parks. The GOGA archivist will maintain reports from the GOGA administered units and PINN. The copies of the reports for each park that were uncovered through data mining will be entered into each park archive as a single unit and submitted to each park.

III. Discoveries and Highlights

Many of the discoveries found during the NPS Inventory Program will affect management of the parks. New populations of sensitive species have been encountered that will need protection. Improved knowledge about species richness and diversity provide larger areas for protection and appreciation. Park planning and mitigation of threats will use vegetation and wetland maps for habitat restoration. Long-term monitoring will use maps and inventory data to locate sample plots and develop sampling schedules. The park staff is actively sharing knowledge across the Network to improve stewardship and with partners to improve regional conservation programs.

Reference information for park

Most inventories that the SFAN I&M Program undertook were for vascular plants and vertebrates; however, several inventories documented unique habitat types such as coastal biophysical and wetlands. Many inventories provided the first systematic survey of particular taxa for the park. The East Bay parks (EUON, JOMU), for example, had no previous natural resource surveys. PINN acquired 8,000 acres of Bureau of Land Management land, which had no previous surveys. All surveys for these areas provided needed reference information.

Landbird surveys were completed in all of the SFAN parks from 1998-2004 to generate reference data about breeding landbirds. Riparian habitats had the highest diversity of bird species. A total of 347 permanent point count stations were established in the parks that can be used for vital signs monitoring. Almost 460 bird species were added to NPSpecies to document bird species presence in the parks.

Accurate vegetation maps based on the National I&M standards will be available to all park units beginning in 2005 except for EUON. The small size and primary cultural landscape component precluded the natural resource mapping effort.

The SFAN mapped wetlands in the parks using GIS modeling with the vegetation map. The map data were then verified with field surveys. Field staff visited a total of 210 study sites (polygons), 43% of the 484 potential wetland polygons in the 2000 draft vegetation map. At least 53% of the wetlands in the study area were not delineated on the USFWS NWI maps, the standard used by wetland authorities. These data are important for identifying, restoring and protecting this important resource. Around 50% additional wetlands were identified in the parks as compared to previous knowledge.

JOMU staff developed reference oak recruitment data as a sub-set to the vascular plant inventory. Even though plenty of seedlings were present, no oak saplings were documented in the 26 transects established randomly throughout the oak-dominated habitats. Blue oaks were the only oak species of the four with more adults than seedlings. The other three oaks are coast live oaks (*Quercus agrifolia*), black oaks (*Q. kelloggii*), and valley oak (*Q. lobata*). Since the lack of regeneration is a serious threat to the long-term health and viability of oak woodlands, this discovery may warrant research into the cause of this bottleneck.

GOGA and PORE gathered reference information for the marine and coastal areas. The ability to safely effectively and safely conduct surveys was weather and tide dependent. Approximately one-third of the coastline was surveyed by an intern from the University of California, Davis. Low tides were needed to access the lower coastal zone. Using methods developed at Glacier Bay National Park, biologists established shoreline transects according to geologic substrate types; and within each transect, completed species surveys and took photographs. Under good weather and tide conditions, Moss Landing Marine Lab used a boat to tow subsurface side-scan sonar to documenting the sub-tidal substrates and biota.

New taxa and records for the parks

New Species

A few new species to science were discovered during the inventories in the SFAN. A new freshwater aquatic worm in the genus *Eremidrilus* was found during the aquatic riparian inventory at PINN from 2001-2004. Steven Fend was sent the aquatic worm samples for identification. He noticed a specimen of *Ermidrilus*, his genus of specialization, which did not match any previously described species. He subsequently obtained a scientific collecting permit and made multiple visits to Chalone Creek. He obtained additional specimens of the new taxa. Chalone Creek is the only locality in which he has found more than two species of that genus.

During the TBBI, scientists identified two new species to science - one crustacean and one anemone. A new species of Leptostracan, *Nebalia* was discovered in Tomales Bay from the coast of central California. Todd Haney, a PhD student at UCLA is revising the phylogeny of the Leptostraca and will describe the new species. An anemone is still being described and status is pending.

New Populations

The Pinnacles riffle beetle is endemic to PINN and surrounding areas. The type specimen for the original species description was collected in Chalone Creek in 1954. During the PINN riparian survey, 2001-2004, it was recorded from 17 samples at 5 sites in a 2-mile stretch of Chalone Creek. Although the species is now known to be more widespread than was previously thought, it is still vulnerable to water pollution and disturbances emanating from all of the PINN developed areas as well as the headwaters outside the Monument.

A highlight of the 2003 enhanced wetland mapping project at PORE was the discovery of a rare plant population. In 2001, a fifth wild population of the federally endangered Sonoma alopecurus was found in Abbott's Lagoon watershed. During the four years of rare plant surveys, three species new to the park were discovered and 148 unrecorded rare plant populations were documented. This increased the rare plant populations by 34%. As a result of all of the new discoveries, PORE will need to develop new management plans for the rare plants. New species include the federally endangered robust spineflower (*Chorizanthe robusta* var. *robusta*), the CNPS listed Humboldt Bay owl's clover (*Castilleja ambigua* ssp. *humboldtiensis*), and the coastal bluff morning glory (*Calystegia purpurata* ssp. *saxicola*).

Many new records for the area and rediscoveries occurred during the vascular plant survey in PINN and JOMU. During the PINN vascular plant surveys, twenty-seven species new to the park were discovered. At JOMU, new records included the Foothill larkspur (*Delphinium hesperium* spp.*hesperium*), which had not been reported in the area since John Muir noted it in his journal around the beginning of the 20th century, and was one of the many species believed to have been extirpated on Mt. Wanda, JOMU, due to extensive grazing through 1992. It was rediscovered.

Two new colonies of ashy storm-petrels were discovered at PORE at Chimney Rock and Stormy Stack. This is an indication that petrels are more widespread in central California than previously thought. The wider breeding distribution lessens the threat of a localized catastrophe extirpating the entire population.

Previously unknown information

Two of the new lichen sightings at PINN documented a first, the globally rare *Texosporium jacobi-sancti* growing on wood and soil. Previously it had been found growing solely on old rabbit pellets. Now, search parameters for this species will need to be expanded.

The California black walnut tree (*Juglans californica* var. *hindsii*) is a Federal species-of-concern. It was quite abundant at both JOMU and EUON during the 2002 vascular plant inventory. It grows in natural riparian habitat as well as in relict orchard areas, where it was used extensively as rootstock for English walnut (*J. regia*). In the orchard areas, many California black walnut trees have grown up and flourished long after their English walnut grafts have died.

The federally endangered California freshwater shrimp was found in Olema Creek, PORE, during a 2002 survey of thirteen creeks in GOGA and PORE. It is still only found within the Lagunitas Creek watershed. Streams chosen for the survey were presumed to have perennial flows, slow moving water, and low gradients, which are all preferred habitat features for the shrimp. By working with ranchers to repair and replace fencing and to remove litter along Cheda, Zanardi, McIsaac, Kehoe, and Home Ranch Creeks, the likelihood of future habitat for the shrimp and other native organisms will be improved.

Odonates (dragonflies and damselflies) are the charismatic megafauna of the aquatic invertebrates. The existence of internet web sites and popular field guides make them ideal for interpreting riparian aquatic macroinvertebrates and stream health to the public. PINN developed a web page describing the Odonates of PINN, which includes a checklist of the 38 species.

The 2001-2004 riparian aquatic species inventory at PINN documented successful reintroduction of the California red-legged frog. Dispersal and reproduction was documented in several downstream locations. All life stages were found.

The federally threatened California red-legged frog had not been found in Tennessee Valley, GOGA for over a decade. In 1993, a survey found one frog in Tennessee Cove Pond, but not in other parts of Tennessee Valley (Ely 1993). Field crews working for the USGS conducted surveys at three ponds in Tennessee Valley in 1995 found none of the threatened frogs. The inventory of amphibian use of seeps, springs, and streams in GOGA in 2003-2005 discovered frogs breeding at two study areas, Tennessee Valley and Big Lagoon.

Tidewater goby (*Eucyclogobius newberryi*), a small federally endangered benthic fish, were historically observed in Lagunitas Creek, PORE in 1953. Since Lagunitas Creek feeds into Tomales Bay, the shoreline of the bay was surveyed from 2002-3. It was documented at a very low density in

one location only, Tomasini Creek. In addition, three non-native species were encountered, two fish and a crab. Surveys conducted by a San Francisco State University graduate student in 2003 focused on the eelgrass, soft-bottom mud, and sand habitats along the periphery of Tomales Bay. No gobies were encountered (Pettigrew 2004). Further studies are needed to determine the conditions that are allowing tidewater gobies to persist in Tomasini Creek and no other location.

Sometimes a survey indicates success if a particular species, such as invasive non-native species, is not encountered. More than 3,600 non-native green sunfish (*Lepomis cyanellus*) were eradicated from PINN in 1998-1999. They were not observed during the riparian surveys from 2001-2004, so they have not re-entered the park.

During the terrestrial vertebrate surveys in the East Bay parks of EUON and JOMU initiated in 2001, two discoveries may generate additional research. No evidence was documented of the native western gray squirrel using remotely sensed cameras. It is not clear if this is a case of displacement by the introduced fox squirrel. In addition, no deer mice were trapped; surprising since that species is common and widespread throughout California.

MUWO supports a diverse bat population. The 1999-2001 field survey discovered maternity colonies of bats using redwood hollows near paved trails. A total of ten bat species were identified during the survey. Inventory investigators recommended that surveys of hollows be done prior to any trail alterations to ensure that maternity colonies are not exposed to human disturbance. Human disturbance to hibernacula is a primary threat to the decline of bat populations throughout their ranges.

IV. Administration of the Inventory Program

General Administration

The superintendents of the SFAN parks developed a charter to institutionalize the basic practices used to plan, organize, manage, evaluate, and modify the SFAN I&M program to meet the purposes of the Natural Resource Challenge with respect to inventories and monitoring of the natural resources in participant parks. The document was signed in June 2001. The charter established a Board of Directors, comprised of park superintendents of four parks as the decision-making body. The Pacific West Region's Regional I&M Coordinator and the Network I&M Coordinator were to serve as ex-officio members. The Board established Point Reyes National Seashore Superintendent Don Neubacher as the chair. All decisions about the SFAN I&M program were made by consensus.

The charter also formed a Technical Steering Committee comprised of park natural resource specialists and the SFAN Science Advisor. The Technical Steering Committee was responsible for compiling and summarizing information about park resources; evaluating initial sample designs, methods and protocols; writing and reviewing annual reports; and providing the Board with recommendations for annual work plans.

The charter outlined that an annual work plan would identify specific projects, responsible individuals, budgets, and deadlines. Available I&M program funds were distributed to parks as directed through the annual work plan. An annual report would be prepared summarizing specific accomplishments and expenditures of funds and submitted to the National I&M Program.

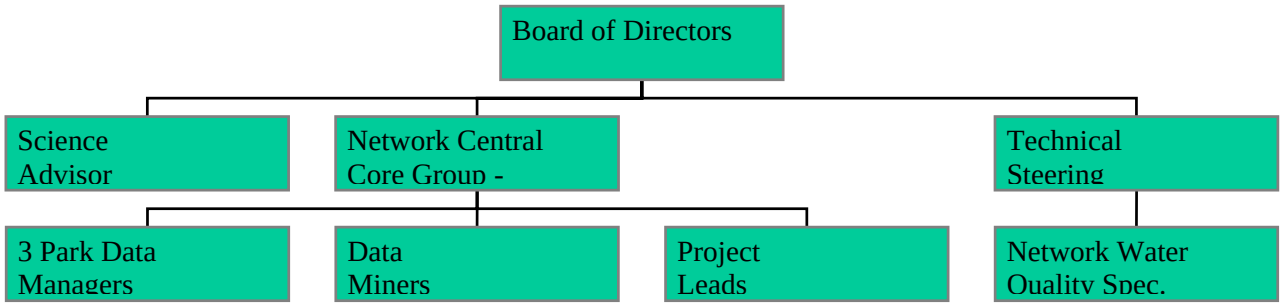
According to the charter, staff hired under the SFAN I&M Program would be supervised and administratively supported by the park or office at which they were stationed. The Network

coordinator, data manager, and biological technician were administered out of PORE. PORE supported Network purchasing, contracting, travel, time and attendance, budget tracking, and vehicles. After a few moves, the duty station for Network personnel was established at GOGA's Fort Cronkhite. GOGA provided IT support, electricity, telephones, and other office-type support.

Organization Structure

The organization chart for SFAN (Figure 5) does not reflect supervisory lines, but does establish important lines of communication. The Science Advisor, Technical Committee and Network Coordinator all worked with the Board and offered suggestions and recommendations for the direction of the Network. Up until 2005, the Science Advisor supervised the Network Coordinator, who is the Chair of the Technical Committee. The Science Advisor also participated as a member of the Technical Committee.

Figure 5. SFAN organization chart through 2004.



All of the NPS staff that provided time and energy to make the SFAN I&M program a success are listed in Appendix F. An average of 22 NPS employees participated in SFAN every year, ranging from 16 to 29 in any given year. During the inventory program period, the core Network staff consisted of four people, the Network Monitoring Coordinator/Data Manager, the Network Inventory Coordinator, the Network Natural Resource Specialist (formerly Biological Technician), and the Network Water Quality Specialist. This group stayed in close communication with the NPS servicewide and regional I&M program offices to ensure that the SFAN program met programmatic direction, needs and deadlines. With assistance, they completed the reports and other products delivered to the servicewide offices.

Data managers were hired for PORE, GOGA and PINN. The Network Monitoring Coordinator/Data Manager provided technical direction but did not supervise them. In 2004, the GOGA Data Manager became the lead Network Data Manager acting as the point-of-contact with the National and Regional programs.

The Data Miners worked on a specific project, were supervised by a member of the Network staff, and communicated with all of the parks. Most projects had project leads from individual parks. Funding and annual work plan goals were provided through the Network Technical Steering Committee to the project leads. Project leads were accountable to the I&M program through the work plan and annual reports.

The Board of Directors decided that all Network staff positions, except for the Network Data Manager, would not be permanent to allow for initial program flexibility. The first position that was filled was the Network Coordinator, in August 2001, as a GS-12. Prior to that, the Network Science Advisor acted as the coordinator (1999-2001). The other network positions were filled in 2002. The Biological Technician was hired as a GS-7 and serviced the small parks, especially those in the East Bay. Since the technician also acted as a Natural Resource Specialist for those parks and did some contract monitoring, the position was elevated to a GS-9 Natural Resource Specialist in FY04.

In FY03, several GS-5 and one GS-6 biological technicians were hired to mine data. Instead of each park trying to piece together staff to do this function, the Technical Steering Committee decided to do

this at the Network level to increase efficiency and consistency. They worked in the same office together and received the same instructions from a single supervisor.

SFAN park personnel participated in the Technical Steering Committee and in focus groups. The three primary focus or working groups included data management, vegetation, and water resources/abiotic. The data/GIS focus group was one of the first to start regular communication to resolve problems, share information, and help each other meet the rigorous servicewide standards for databases. Metadata training was held in FY02 and NPSpecies certification training in FY04. Members of the focus groups are also provided in Appendix F.

The abiotic focus group began discussions during the PINN soil scoping meeting in FY02. Soil structure, erosion, plate tectonics and geomorphology were some of the topics that this group discussed. Initial issues that they started to address included updating park soil maps and obtaining geological hazard maps from the USGS. This group also worked on identifying needed water resource studies and merging water resource sampling with weather station monitoring.

The vegetation working group was formed and developed a comprehensive implementation strategy for three of the top vital signs dealing with plants. They developed the recommended work plan for the SFAN Natural Resource Specialist.

Identification of Inventory Projects

Thirty-eight participants met at an August 2000 workshop to initiate the development of the *SFAN Inventory Study Plan*. Six of the participants were recipients of early contracts and agreements. Once it was approved by the national I&M program, the Plan became the work plan for the SFAN Inventory Program.

Workshop groups developed the percent completeness for each park by taxa, as shown in the Study Plan. Some of the data gaps that emerged were not from a lack of surveys but due to incompleteness of the nationwide databases. Species presence data or citations were missing. To resolve this problem, the group recommended data mining.

The national program recommended concentrating inventories on vascular plants and vertebrates; however, this did not preclude inventories of invertebrates or non-vascular plants. For example, the workshop identified marine invertebrates in the intertidal zone as the most important community to inventory for this ecosystem. Inventory projects were recommended to address the data gaps that could not be resolved through data mining. The greatest inventory needs were at EUON, JOMU, the newly acquired lands at PINN, and the marine ecosystem. The bat taxa had also not been surveyed in most parks. Thirteen projects were identified in the Plan. The rare and sensitive species, non-native species, and unique habitats for which there was a lack of information were also listed. After ranking, the Steering Committee forwarded to the national program a total of 22 projects for approval and implementation.

[Note that per the guidance of the National I&M Program, sections of this chapter including tables and figures pertaining to detailed budget expenditures have been removed from this public document.]

V. Status of SFAN Inventories

In summary, field work for 26 of the 32 inventory projects that the SFAN implemented were completed (81%; Table 20). By the end of 2004, all of the deliverables (report, data, GIS, photographs, specimens, and field notes) for nine of the projects (28%) were submitted to the new Biodiversity Store. Most inventories took a minimum of two years to complete. After the work plan was developed, a minimum of one full year of field surveys was needed to capture seasonality. Then the post data analysis and report writing were needed. The project wasn't considered complete until all of the deliverables had been received, reviewed and accepted.

Table 20. Status of the inventories conducted between 2000 and 2004.

Project	Total # of inventories	Initiated surveys	Completed the field survey	Submitted products Biodiversity Store
From Inventory Study Plan				
Data inventory (All)	1	1	1	1
Inventory workshop (All)	1	1	1	1
Vegetation mapping (GOGA/MUWO/PORE, PINN)	2	2	1	0
Multi-species inventory (EUON/JOMU/PORE)	2	2	2	0
Herbarium assessment (GOGA/PINN/PORE)	1	1	1	0
Vegetation inventory (vascular plants) (JOMU)	1	1	1	1
Vascular plant inventory, new lands (PINN)	1	1	1	0
Rare plant inventory (GOGA, PORE)	2	2	2	1
Salt marsh harvest/Pt. Reyes jumping mouse (GOGA)	1	1	1	1
Bat inventory (EUON/JOMU/PORE, GOGA, PINN)	3	3	1	0
Small mammals/ herpetofauna inventory (PINN)	1	1	0	0
Riparian aquatic species inventory (PINN)	1	1	1	0
Coastal biological inventory, nearshore fish (GOGA/PORE)	2	2	1	0
Sub-tidal and deep water inventory (GOGA/PORE)	1	1	0	0
Bird inventory (EUON/JOMU, PINN)	2	2	2	0
Sub-total	22	22	16	6
Accelerated from unfunded Plan needs				
Lichen inventory (PINN)	1	1	1	1
Hymenoptera/butterfly inventory (JOMU)	1	1	1	0
California freshwater shrimp inventory (GOGA/PORE)	1	1	1	0
Ashy storm-petrel inventory (GOGA/PORE)	1	1	1	1
Wetland map/inventory (GOGA, PORE)	2	2	2	0
Sub-total	6	6	6	2
Added new inventory projects				

Project	Total # of inventories	Initiated surveys	Completed the field survey	Submitted products Biodiversity Store
Data mining (All)	1	1	1	0
Geomorphology, Strentzel canyon (JOMU)	1	1	1	0
Vegetation map (JOMU)	1	1	1	0
Soil scoping (PINN)	1	1	1	1
Sub-total	4	4	4	1
TOTAL	32	32	26	9

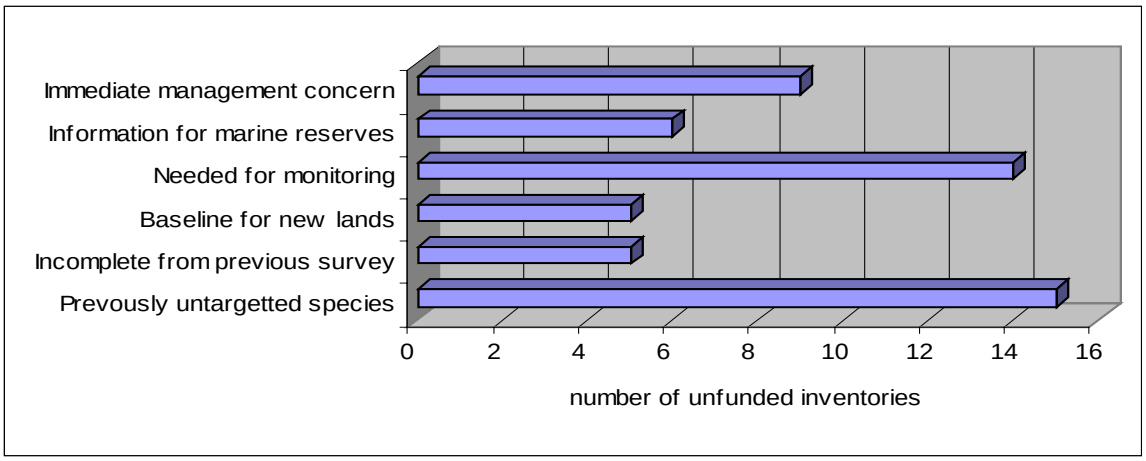
As projects were completed, projects in the "unfunded" category were initiated. In one study, the salt-marsh harvest /Point Reyes jumping mouse inventory, only one watershed was done because of lack of funds. The majority of these "unfunded" projects was small in scope and had small budgets; therefore, five of them were completed.

Forty projects were identified as inventory needs in the *2000 Inventory Study Plan*, including both funded and unfunded categories. Only 7 projects from the Plan have not been started (17.5%). Field surveys were completed and final reports were received for 21 of the 40 projects (52.5%).

The five years from 2000 through 2004 helped the SFAN parks complete needed inventories for vascular plants and vertebrates. Information gaps for non-vascular plants and invertebrates remain, especially the marine species that provide structure and habitat characteristics similar to those provided by terrestrial vascular plants.

After a meeting of the Steering Committee in January 2005, remaining inventory needs were identified. Six types of need were identified as important and provided a reason to keep the inventory project on the list (Figure 9). A total of 25 inventories were identified as still needed. Five projects were already underway but needed additional funding for completion. Fourteen projects were needed to provide important information for the development of vital signs monitoring. Nine projects were identified as immediate management concerns, including the baseline surveys and maps of the newly acquired lands in GOGA and PINN. Six projects were for under-surveyed marine resources that would add information for potential designation of marine reserves.

Figure 6. Unfunded inventory by reason for the need.



During a second meeting of the Steering Committee, the potential inventory projects were grouped into high, medium, and low priorities in order to develop a plan to meet inventory needs over the next five years. The Committee identified project leaders who were responsible for the development of the study plan, budget, and eventually implementing the funded projects. The initial work will be for those projects ranked as a high priority. Details for the remaining projects will be minimal until time is available to develop and implement them.

Table 21 lists the remaining SFAN unfunded inventory projects grouped alphabetically by priority. The majority of the projects are for the three big parks, GOGA, PINN, and PORE. The complete spreadsheet and individual projects are explained in Appendix H. Most remaining inventories are multi-year surveys or they exceed the funding availability of the network, particularly marine ecosystem inventories. Funding from other sources will be required to augment these projects. The SFAN I&M program is presently only providing "seed" funds for cost sharing with partners.

Table 21. Unfunded SFAN inventory needs

Project (indicator #)	Reason									Project
	Needed	EUON	FOPO	GOGA	JOMU	MUWO	PINN	PORE	PRES	Lead
High priority - 8										
Aquatic vasc. plants (15)	monitoring			X				X		Fritzke/Rodgers
Coastal biological (19)	incomplete			X				X		Schirokauer
Freshwater bivalves (5)	monitoring			X				X		Fong/Ketcham
Natural soundscape	prototype					X		X		Schirokauer
Sub-tidal/deep water	incomplete			X				X		Becker
Vasc. plant, new lands (2,6,9)	monitoring			X			X			Franklet/Fritzke
Vegetation map (all)	monitoring						X			Franklet
Veg. map, new lands (all)	monitoring			X			X			Franklet/Fritzke
Wetland map/inverts (15)	monitoring			X						Fong

Project (indicator #)	Reason Needed	EUON	FOPO	GOGA	JOMU	MUWO	PINN	PORE	PRES	Project Lead
Medium priority - 4										
Herps, new lands (8)	monitoring			X			X			Petterson/Merkle
Landbirds, new lands (17)	monitoring			X			X			Merkle/Petterson
Lichens (4)	monitoring	X	X	X	X	X			X	TBD
Macro-inverts/plankton	marine		X	X				X		Adams/Fong
Low priority - 13										
Bats, natural habitat	Study Plan			X			X	X		Petterson
Cave invertebrates	inverts						X			Petterson
Coastal caves	marine			X				X		Hatch
Data mining/entry/cert	incomplete	X	X	X	X	X	X	X	X	Koenen
Dune invertebrates	inverts			X				X		Adams
Fire history	park need				X					?
Geologic hazards	park need	X	X	X	X	X	X	X	X	Koenen/GRD
Intertidal/beach invert	inverts			X				X		Adams
Mammals, new lands	baseline			X			X			Merkle/Petterson
Seabirds, cavity nest.	marine			X				X		Merkle/Allen
SM/PR mice	incomplete			X				X		Adams/Merkle
Soil maps (20)	monitoring				X		X			Koenen/GRD
Sub-tidal fish	incomplete			X				X		Becker/Fong
Total # of inventories for each park		3	4	21	5	4	11	15	3	

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